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The Anatomy of the Intestinal Canal and Peritoneum in Man.

By

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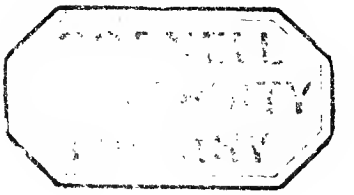

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The Anatomy of the Intestinal Canal and Peritoneum in Man.

I.

THE account of the intestinal canal and peritoneum in man that is here presented is derived from the systematic examination of one hundred fresh bodies. Through the kindness of my colleagues, Drs. Sutton and Turner, the pathologists to the London Hospital, I was enabled to open, before the performance of the usual necropsy, all the bodies of patients who had died of other than abdominal disease. The bodies, therefore were quite fresh, and, in many instances, still warm. I had long been convinced that a study of this part of anatomy was rendered liable to many fallacies when conducted in dissecting-room subjects in whom decomposition had advanced, and in whom one could expect, for various reasons, some displacement of parts.

Certain questions as to vascular-supply I have followed out in injected preparations. I have also derived considerable information from the dissection of a number of fœtuses of various ages.

Moreover, through the kindness and courtesy of Mr. Beddard, the Prosector to the Zoological Society, I have been enabled to make a detailed examination of the viscera of many of the Mammalia, the examination including the dissection of forty different species. This latter work has been of the greatest service in throwing light upon many obscure points in human anatomy.

2.—Length of the Intestinal Canal.

The first question that may be considered is that which concerns the length of the intestinal canal in the human subject. I have made careful measurements in every instance, but the results, although voluminous enough, have been somewhat barren in interest.

I find that the average length of the small intestine in the adult male (between the ages of 20 and 50) is 22 feet 6 inches, the extremes being 31 feet 10 inches in one case, and 15 feet 6 inches in another. The average length of the same part in the female is 23 feet 4 inches, the extremes being 29 feet 4 inches and 19 feet 10 inches respectively. The average length of the colon in the same set of subjects, is 4 feet 8 inches in males, and 4 feet 6 inches in females, the measurement being taken from the root of the appendix, or tip of the cæcum, to the point where the meso-rectum ended. The extremes were, for both sexes, respectively 6 feet 6 inches and 3 feet 3 inches.

I have convinced myself that the length of the bowel is independent, in the adult at least, of age, of height, and of weight; nor is the ratio between the measurements of the small and large intestine constant. A very long small intestine may be associated with a very short colon, or *vice versâ;* or both segments may be unduly long or unduly short. Moreover, advancing age appears to have no influence upon the length of the intestine. The measurements of the bowel in subjects above the age of 50 years, are practically identical with those that have been just detailed.

I think, therefore, that it must be allowed that the differences in the length of the intestine—differences that, in the lesser bowel, may actually reach to no less than 15 feet—depend upon physiological, and not upon morphological, data. It is not unreasonable to assume that the nature of the food, the vigour of the digestive process, the activity of the abdominal nervous centres, will have more concern in determining the length of the bowel than will the height and age of the individual; and it may be that a time will come when physiologists will be able to express the value of certain alimentary functions in feet and

inches. A study of the comparative length of the intestines in animals certainly seems to support a belief in the physiological bias.

The history of the growth of the bowel in infancy presents, however, some features of more definite interest.

In the fœtus at full term, the length of the intestine, and especially of the colon, is singularly constant. The average measurement of the small intestine is 9 feet 5 inches, and of the large, 1 foot 10 inches. So regular are these measurements, that the greatest variation I have met with in the lesser bowel amounted only to two feet, while in the colon it was as little as five inches. During the first month after birth, it may be reckoned that the small intestine will grow about two feet; and a like rate of growth may usually be recorded at the end of the second month of extra-uterine life; but after that period, the development of the lesser bowel proceeds in a most irregular manner. Thus, in a child of one year the small intestine measured 18 feet; while in another, aged two years, the length was only 13 feet 8 inches. Again, in one subject, aged six, the lesser bowel was no less than 21 feet in length; while in another child, eleven years of age, its length attained merely to 14 feet.

It will be needless to observe that this growth of the small intestine has no concern with the general growth of the body; nor does it bear any relation to the weight of the child. Growth is intimately associated with activity of function; and the diet of young children among the poorer classes is often so unsuitable and erratic, that one must expect that the developing intestine is exposed to many fluctuations of fortune, and to many vascular vicissitudes. In one instance, the nature of the nourishment may lead to an apathetic, dull, and anæmic condition of the bowel; while in another case it may foster a perpetual intestinal tumult. It is impossible that such opposite conditions can have no effect upon growth; and when it is remembered that all children start life with practically the same length of intestine, it is difficult to ascribe the extraordinary variations in growth that are conspicuous in the bowel during the early years of existence to other than physiological influences.

With regard to the growth of the colon, we may anticipate less conspicuous fluctuations. The functional activity of the large intestine

is infinitely less than that of the small. Indeed, the colon is little more than an internal receptacle, provided in order that fæcal matters may be voided at intervals; and, in a certain physiological sense, the real anus is at the ileo-cæcal valve. The length of the colon in the fœtus at full term is 1 foot 10 inches. When I came to examine my notes as to the length of the colon in infancy, I found that the measurement of this segment of the bowel at the age of one month was 1 foot 10 inches; at the age of two months, it was still the same; nay, more, at three months, and even at four months, it was still the same—1 foot 10 inches. After this period it grew steadily and regularly. In a subject a year old, it measured 2 feet 6 inches; at six years, it was about 3 feet; and at thirteen years of age, it was about $3\frac{1}{2}$ feet in length.

The absence of growth in the colon for at least the first four months of extra-uterine life is certainly remarkable. It is remarkable in this sense: in the fœtus, the sigmoid flexure forms an enormous loop; it measures no less than 10 inches; while the rest of the large intestine measures a foot. Now, after birth the sigmoid flexure rapidly ceases to be so exceedingly conspicuous; it soon begins to conform to the condition met with in the adult body; and, indeed, by the fourth month this segment of the bowel has relatively all the characters of the loop in the full-grown individual. When measurements came to be examined I found that the main part of the colon was growing at the expense of the sigmoid flexure; so that, in a subject that had reached the age of four months, this flexure measured only 6 inches, while the rest of the colon had acquired the length of 1 foot 4 inches. During this period of time, therefore, there had not been growth in length, but merely a readjustment of parts—a compensatory arrangement in subtraction and addition. It is peculiarly interesting to note that this rearrangement takes place without conspicuous disturbance of the investing serous membrane.

3.—The Duodenum.

The length, course, and relations of the duodenum are singularly constant, and exceptions to the condition detailed in the familiar account of this portion of the bowel are exceedingly rare.

In the anatomical text-books, the duodenum is said to describe a single large curve of an almost circular shape, and is divided into three portions—an ascending, a descending, and a transverse. The first portion extends upwards, backwards, and to the right, to a point just beneath the neck of the gall-bladder. The next segment passes downwards as low as the second or third lumbar vertebra; while the third division crosses the column obliquely from right to left in front of the second lumbar vertebra. The end of the duodenum is thus clearly to the left of the spine. The first portion is invested by peritoneum, like the stomach; the second portion is covered by the serous membrane on its anterior surface only; while the third part receives a partial investment upon the same surface.

If the jejunum be considered to commence at a spot where the gut receives a complete investment of peritoneum and a distinct mesentery, then to the above description of the duodenum should be added a fourth, or second ascending part. This fourth portion is practically constant. When the bowel has reached the left side of the column, it ascends vertically by the side of the spine. This vertical portion—which is covered entirely in front, and partly at the sides, by peritoneum—I have never found to be less than one inch in length. One anatomist (Dr. Bruce Young, *Journal of Anatomy and Physiology*, 1884, page 100) has recently described this terminal vertical portion, and insists that it is a constant feature in the normal duodenum. In one body, that of a male adult, I found this vertical portion so extensively developed, that the end of the duodenum was carried far up on to the under surface of the transverse meso-colon.

The relatively small size of the duodenum, and its relation to the serous membrane, are points that are distinctive of the bowel in the higher Mammalia. Speaking generally, it may be said that, in mammals, the duodenum forms a large loop, describes a regular and well-rounded curve, and is provided with an extensive meso-duodenum. In the primates, the meso-duodenum begins to disappear. In the ring-tailed lemur, there is a small but distinct meso-duodenum. In the common marmoset, this fold is but slightly represented; while, in the fourteen different species of apes that I have examined, the peritoneum had practically the same relation to the gut that it has in man. The curve

of the duodenum, however, varies greatly in monkeys. One extreme is represented by the simple angular horizontal bend met with in the Bonnet monkey and Barbary ape (Fig. 1 A), and another by the extensive vertical loop which I find that the duodenum describes in the Spider monkey (Fig. 1 B).

It is important to recognise that the end of the duodenum is very firmly fixed in its place by the musculus suspensorious duodeni. This name has been given to a fibrous band, that contains, according to Treitz, some plain muscular fibre, and that descends to the vertical part of the duodenum from the left crus of the diaphragm, and the tissue about the cœliac axis.

4.—The Fossa Duodeno-Jejunalis.

The points about the duodenum to which I would direct especial attention concern the fossa duodeno-jejunalis. This fossa has received little notice at the hands of anatomists, although it possesses great anatomical interest. It deserves attention, also, as being the seat of origin of retroperitoneal or mesenteric hernia, a form of rupture of which nearly fifty examples have been placed on record. If the transverse colon be thrown upwards, and the small intestine be drawn well to the right, the termination of the duodenum and commencement of the jejunum will be clearly displayed. The terminal part of the duodenum is covered in front by peritoneum. This covering is continuous above with the under layer of the transverse meso-colon, and below with the peritoneum covering the front of the lumbar spine, and passing down into the pelvis. On the left side, it is continuous with the serous membrane that invests the kidney and descending colon; while, on the right, it joins the mesentery of the small intestine.

When the fossa exists, a fold of serous membrane will be seen to pass from the parietal peritoneum, just to the left of the terminal part of the duodenum, and to be attached, in a vertical line, to the anterior surface of this portion of the bowel (Fig. 2). This fold, which is called the plica duodeno-jejunalis, forms above a free crescentic margin, which

looks directly upwards ; while, on all other sides, it is continuous with the peritoneum on the duodenum and posterior parietes. The fold is clear and translucent, is singularly free from fat and blood-vessels, is composed of two layers of the serous membrane, and forms a well-defined pouch or pocket in the peritoneum.

The lateral attachment of the plica on the left side very commonly corresponds to the inferior mesenteric vein. It may come off between the vein and the duodenum, but never, so far as I have seen, from the peritoneum to the outer side of this vessel. To the bowel the plica is attached vertically, and nearly always along a line that separates the middle third from the left-hand third of the gut. It may be attached nearer to what may appear to be the centre of the bowel, but it is significant to note that, in any case, the line of attachment, if followed up on to the jejunum, will be found to be opposite to the line of attachment of the mesentery.

The pocket, or fossa, formed by this fold, is of triangular outline, with its base above. The opening of the fossa looks directly upwards. Its apex extends below the bend of the duodenum, a fact of significance in connection with the development of the fossa. The anterior wall of the pocket is formed entirely by the fold ; the posterior wall is formed by the posterior parietes and part of the duodenum, both covered by peritoneum.

The capacity of the fossa varies greatly. In well-marked specimens, it has a vertical depth of $1\frac{1}{2}$ inches ; and will lodge the thumb up to the first joint. It will often take only the point of the little finger, and in some instances will readily receive two fingers as far as the first joints. The fossa normally lodges the duodeno-jejunal bend ; and the production of a retroperitoneal hernia, by the protrusion of additional gut into this pouch of peritoneum, can be readily understood.

The plica and its pouch, although not constant, are met with with equal frequency in both males and females, and in individuals of all ages. Among the specimens selected as typical was one from a male fœtus at full term, and another from a woman aged eighty-two. In the one hundred bodies examined, I found forty-eight examples of this fossa duodeno-jejunalis. Among the variations met with in the fossa, the following may be noted.

The pouch may be very shallow, on the one hand (Fig. 3 A) or very long, narrow, and deep, on the other (Fig. 3 B). It may be placed at some distance from the duodenal bend (Fig. 3 C). It may be reduced to a very minute pouch of serous membrane limited to the duodenum alone (Fig. 3 D). Its opening may be in the form of a distinct ring: that in the specimen depicted would just admit a No. 12 catheter (Fig. 3 E). The pouch may be of remarkable breadth, and lodged in a conspicuous transverse fold running from the inferior mesenteric vein to the right-hand border of the duodenum (Fig. 3 F). And lastly, the lower part of the pouch may be deficient, and the plica be represented by a simple transverse band running between the usual points of attachment (Fig. 3 G).

Before discussing the origin and mode of formation of the plica duodeno-jejunalis, it may be convenient to consider the relation that it bears to the inferior mesenteric vein. Although this vessel is closely associated with the plica, and although it is well known that many peritoneal folds are caused by the blood-vessels, yet I would venture to express a belief that this particular vein has nothing to do with the formation of this particular fold. It is well known that this vein is somewhat uncertain in its mode of ending, but the one hundred specimens that I have examined show that the presence or absence of the plica is in no way influenced by the mode of ending or the disposition of the vein.

In the human subject, the vein may end in one of three ways: 1, it may enter the superior mesenteric vein precisely at its junction with the splenic (Fig. 4 A); 2, it may enter the former vein at some distance from the splenic (Fig. 4 C); 3, it may enter the splenic vein at a right angle (Fig. 4 B). In one hundred specimens, the vein was disposed as follows: condition 1 = 44 per cent.; condition 2 = 36 per cent.; and condition 3 = 18 per cent. In the remaining two cases, the vein took a remarkable course. It ran vertically upwards in front of the splenic vein, passed between the layers of the transverse meso-colon, parallel with and two inches from the bowel, and, having described an extensive curve, entered the superior mesenteric vein on its right side (Fig. 4 D). This is not unlike the course adopted by the vessel in some animals, and the abnormal trunk was no doubt due to an enlargement of the communicating branch between the inferior and superior mesenteric

veins, that normally runs in a curved manner along the transverse meso-colon.

The ending of the inferior mesenteric vein in the splenic would appear to be a feature in the higher development of animals. In certain of the Mammalia below monkeys, the inferior mesenteric artery is a branch of the superior mesenteric, and the vein that accompanies the former vessel enters either the trunk of the superior mesenteric vein, or at the point where that vessel joins the splenic. In none of the Mammalia below monkeys have I found the inferior mesenteric vein ending in any other way. In the last-named class of animals the inferior mesenteric artery comes off from the aorta, and the companion vein ends most usually in the angle of junction of the superior vein with the splenic. It may enter the trunk of the superior mesenteric vein some distance below the termination of that vessel. In only two instances, namely, in a Bonnet monkey and in a Silvery gibbon, did I find the inferior mesenteric vein discharging itself into the splenic.

In man the inferior mesenteric vein takes a sharp curve before it ends, especially when it terminates in the superior vessel. It passes under the lower border of the pancreas and behind the end of the duodenum. Before it is hidden by the pancreas it often draws the serous membrane into a fold, near the free edge of which the vessel runs. This fold will be concave downwards, and will limit a fossa of varying dimensions that may pass up, as a kind of pocket, behind the lower edge of the pancreas. The fossa is sometimes large enough to conceal the thumb up to the root of the nail, and looks directly downwards. It often co-exists with the fossa duodeno-jejunalis, which it then serves to deepen; and is most usually met with when the inferior mesenteric vein ends either in the superior mesenteric, or at the point where that vessel joins the splenic (Fig. 5 A). Two quite unusual forms of this pouch are shown in Figs. 3 H and 3 I.

I believe this pouch to be of no practical importance, to have no interest either with regard to development or comparative anatomy, and to be in no way concerned in the production of internal hernia. I take it to be simply of the same nature as the folds that are frequently formed in the peritoneum by blood-vessels. Good examples of such folds are found about the cæcum, and a striking instance from the peritoneum

near the descending colon is shown in Fig. 5 B. To these vascular folds, and especially to the latter, I shall have occasion to allude later on.

5.—The Formation of the Fossa Duodeno-Jejunalis.

The mode of formation of the fossa duodeno-jejunalis may now be considered; and, to render the account of its formation intelligible, some reference must be made to the general development of the intestinal tract. In its most primitive condition, the alimentary canal appears as a simple vertical tube, running down in the middle line, and connected to the spine by a simple vertical fold of peritoneum (Fig. 6 A). In a little while, the upper part of the tube enlarges, and becomes bulbous, and the rudimentary stomach is produced. The lower part of the tube retains its primitive connection with the spine, and retaining also very nearly its original vertical direction, becomes the descending colon and rectum, including a part also of the transverse colon. In fact, it persists as all that segment of the large intestine that is supplied by the inferior mesenteric artery. The intermediate part of the primary tube increases rapidly, and soon forms a large loop, which projects out of the still shallow abdominal cavity, and from which the intestine, from the pylorus to about the middle of the transverse colon, is ultimately developed.

There is at first nothing to indicate the separation of the large intestine from the small; but soon a bulging takes place, at a point just behind the apex or middle of the loop; and this, in process of time, develops into the cæcum and its appendix. This large loop has a common mesentery, continued from the original vertical mesial fold of serous membrane that connected the primary intestinal tube with the spine. The loop has a narrow neck, formed above by the duodenum, and below by that part of the large intestine that subsequently becomes the right extremity of the transverse colon. Between these two segments of gut, at the neck of the loop, the superior mesenteric artery runs to supply the bowel. As it runs in the mesentery, it gives off branches from its right or upper side to supply the small intestine, while from its left border arise the vessels for the cæcum and ascending colon (Fig. 6 B).

The intestine in the loop grows rapidly, and the mesentery increases in a corresponding ratio. That part of the membrane, however, that lies at the neck of the loop does not grow at the same rate. Thus it is, as Professor Flower has well pointed out, that the duodenum and the right end of the transverse colon never lose their primitive relation, in spite of the many subsequent changes that take place in the position and growth of the viscera. They continue to limit and bound the neck of the mesentery; and, as growth proceeds, this neck or root becomes proportionally narrower, while through it still runs the trunk of the superior mesenteric artery. In time, the great loop is withdraw into the abdomen, and becomes twisted upon itself in a remarkable but definite manner. This twisting is due, in the main, to unequal growth in the two sections of the loop; for, while the small intestine has been increasing in length with great rapidity, the colon has grown comparatively but little.

Just before the twist takes places, the cæcum will probably be lying about the umbilicus, and will be placed, together with the rest of the large intestine, wholly to the left of the middle line.

When the change in position occurs, the cæcum mounts up towards the right hypochondrium; it passes in front of the loop of the duodenum, and ultimately descends to its final resting-place in the right iliac fossa. As a result of the twisting, the small intestines are turned towards the left side; what was originally the right side of the mesentery becomes the left side; and the vessels to the small intestine are seen to come off from the left border of the superior mesenteric artery, instead of from the right. The mesentery has been rotated, in fact, half a circle. At the narrow neck of the great loop, the changes are less conspicuous. The right end of the transverse colon has passed in front of the duodenum; but those parts of the bowel still form the boundaries of the narrow neck of the mesentery, and between them still passes the superior mesenteric artery.

As development proceeds, the bowel grows somewhat out of proportion to the peritoneum about it, and this disproportionate growth is well marked in the two segments of gut that form the neck of the great intestinal loop. As they grow, they become too large for their serous coverings; they to a great extent grow out of them, and thus it happens that the duodenum and transverse colon are brought nearer

and nearer together, until at last their relations are very intimate, although their mutual positions have become modified.

The development of the duodenum itself may now be considered. This part of the gut forms a loop of its own; a loop that starts from the pylorus, and ends where the gut becomes fixed by the musculus suspensorius. Its termination, therefore, is at the neck of the great general intestinal loop, and close to the trunk of the superior mesenteric artery. The duodenum, which is at first comparatively of large size, has its own meso-duodenum, which is attached vertically to the middle line, being a part of the original mesial mesentery. When the pylorus moves to the right, the loop of the duodenum moves with it, so that the left layer of the meso-duodenum becomes anterior, and the right layer posterior.

When the twist takes place in the intestinal loop, the duodenum has no share in it. The general position of the loop remains unchanged. The end of the duodenum is dragged across the middle line from the right side to the left, the superior mesenteric artery passes over it instead of by its side, the dragging produced by the upward movement of the colon causes the terminal part of the duodenum to become vertical, and a sharp twist is formed in the gut where the duodenum and jejunum meet. The meso-duodenum and the mesentery are no longer continuous in the same plane. In time, the duodenum loses its mesenteric fold, partly because it grows out of proportion to the peritoneum, and partly because developing viscera in its neighbourhood draw the serous covering from it, and ultimately it actually acquires a large non-peritoneal surface.

The question now arises, as to the origin of the fossa duodeno-jejunalis; and that question can be best considered by leaving for a while the development of the parts in the human fœtus, and picking up the thread among some of the lower mammalia. What has been said of the development of the intestines in man will apply equally in all general points to the rest of the mammalia. We are, however, especially concerned now with the duodenum. In nearly all mammals —with the exception of the monkeys—the duodenum retains its mesentery. This fold is often very extensive; it is not in the same plane with the mesentery of the small intestine; it is attached vertically along

the middle line, and its posterior or right layer is continuous above with the corresponding layer of the gastro-hepatic omentum. It persists, in fact, as a part of the original primitive vertical serous fold. The duodenum ends, as in man, to the left of the middle line, or rather to the left of the trunk of the superior mesenteric artery, and where it ends the bowel undergoes a very abrupt and pronounced twist. As a fairly typical example of the condition of parts, I have selected the duodenum of a hyæna, and the drawing is from a dissection of an adult female (*Hyæna striata*), Fig. 7. It will here be noticed that from the terminal part of the duodenum a vertical fold comes off, which is attached precisely along the middle line, and which, indeed, arises from the same line as the descending meso-colon.

So far as I can ascertain, this fold has been barely noticed by anatomists, although it is almost constant where a meso-duodenum exists. The fold is singularly free from blood-vessels, and is attached to the duodenum along a line precisely opposite to the attachment of the meso-duodenum. It ends below in a free fold that is concave downwards. I have seen a like fold in a small human fœtus, in whom the meso-duodenum had not yet been obliterated. The fold is evidently nothing more than the continuation back to the spine of the meso-duodenum. The terminal part of the gut has been drawn up between the folds of the serous membrane, partly by the effects of its own growth, partly by the traction of the rapidly developing small intestine. The free edge of the fold represents the inferior limit of the meso-duodenum before the terminal part of the gut has become vertical.

Owing to the enormous development of the duodenal loop as compared with that of the lower colon, the meso-duodenum, that was originally above the meso-colon and in the same vertical line with it, has descended by the side of the latter until the two have at last become parallel. They are, indeed, fixed together at the spine. In many animals, owing, I imagine, to continued growth of the meso-colon, this duodenal fold has been carried with the latter from the spine; so that in such cases it appears to be inserted in a vertical line to the right layer of the descending meso-colon at a certain distance from the column. I venture to think that it is from this fold that the plica duodeno-jejunalis is produced.

In the first place, I may state that I have found no trace of this plica, nor of the fossa it produces, in any one of the animals I have dissected. In two of the carnivora, namely in a Puma and in a Cape Hunting Dog, I found a fossa in the peritoneum, at a point where the meso-duodenum and the mesentery met. The fossa was placed transversely, was at some distance from the spine, was apparently due to the rotation of the bowel, and had no resemblance to the duodenal fossa in man.

It would appear that the fossa follows upon the obliteration of the meso-duodenum. This obliteration depends in part, upon the growth of the duodenum itself, and, in part, upon the re-arrangement of the peritoneum during the progress of development. The proportion of peritoneum to intestine is much greater in the lower animals than it is in man. In most of the mammalia, there is an extensive mesentery and a meso-duodenum, the ascending colon is free, the transverse colon supplied by a liberal fold, and the descending colon attached by means of a large meso-colon. In man, on the other hand, the ascending colon has usually a large non-peritoneal surface. It has outgrown its serous covering. The descending colon, moreover, has been removed far to the left of the middle line, and very commonly has no meso-colon. Even when such exists, it will be no longer attached along the middle line in the place of the original fold. In most apes, the descending meso-colon, which is always present, is still attached practically along the middle line. In the Gibbon its attachment is transferred to the inner edge of the kidney, but in no ape that I have so far seen has the peritoneum been encroached upon to the extent that is so noticeable in man.

In the human fœtus, the meso-duodenum is probably obliterated by the downward growth of the cæcum. This part of the colon, as it develops, would drag upon the peritoneum, and would tend to obliterate all folds. More peritoneum is required by the cæcum and ascending colon, and it is obtained from that of the posterior parietes, and, in great measure, by the unfolding of the meso-duodenum. By such unfolding, the posterior layer of the meso-duodenum is dragged away from the loop, which now lies with its hinder surface bare ; and what was once this posterior layer comes to line the adjacent part of the parietes below

and to the outer side of the duodenum. The anterior layer of the meso-duodenum remains. It will be seen that, by such unfolding, the vertical fold from the duodenum (Fig. 7) will become obliterated; and the condition may thus be brought about that is met with in most apes, and in such human specimens as are marked by the absence of the plica duodeno-jejunalis.

But the dragging of the peritoneum is not all in one direction. The left part of the colon is making almost equal claims upon the serous membrane, and is tending to drag it from the posterior parietes towards the left side. In this way the vertical fold would be carried towards the left, and be moved in an upward direction; and would persist, if the demands upon the peritoneum cease, as the plica duodeno-jejunalis. The free edge of the plica will correspond to, although it will not be identical with, the free edge of the vertical fold.

It is not necessary to assume that the duodenum moves with the shifting serous membrane. Repeated illustrations are afforded elsewhere, to show that peritoneum can be readjusted without involving equivalent displacement of the viscus that it covers.

It is significant to note that both the plica and the vertical fold are attached to the same part of the duodenum, and along precisely the same line. They are both, moreover, conspicuous by their thinness, and by the absence of visible blood-vessels

Several instances have been reported in which, as the result, probably, of intra-uterine peritonitis, the intestines have continued to occupy in the adult the position assumed in early fœtal life. In such cases, the colon is found wholly to the left of the middle line, while the small intestines occupy the right side. The bowel has not been rotated in the usual manner, and the vasa intestini tenuis still arise from the right side of the superior mesenteric artery. The duodenum is quite to the right of the spinal column. Abnormalities of this description have been noted by Sir James Simpson (*Edinburgh Medical and Surgical Journal*, 1839, p. 26), Dr. Hilton Fagge (*Guy's Hospital Reports*, vol. xiv.), Mr. Lockwood (*British Medical Journal*, vol. ii, 1882, p. 574), Professor Chiene (*Journal of Anatomy and Physiology*, 1868, p. 15), Dr. John Reid (*Edinburgh Medical and Surgical Journal*, 1836, p. 70), and Dr. Bruce Young (*Journal of Anatomy and Physiology*, 1884, p. 98).

In the description of the parts given by the last named observer in a very able paper, this significant passage occurs: "Extending downwards from the inner side and apex of this curve of the duodenum, in the vertical antero-posterior plane, was a membranous layer, about two inches broad and one inch long, which lay two inches to the right of the middle line of the abdomen, and was attached below to the upper surface of the mesentery." Dr. Bruce Young thinks that this fold was a morbid adhesion; but one cannot fail to be struck with its resemblance to the vertical fold met with in animals, and which one would expect to find in this particular abnormality of the bowel.

6.—The Fossa Duodeno-jejunalis and Retroperitoneal Hernia.

It has been already said that the fossa duodeno-jejunalis has been credited as the cause of retroperitoneal hernia. If such a rupture form, the pocket becomes enlarged, and lodges more and more of the small intestine. The bowel finds its way behind the peritoneum; and in a complete case, such as that described by Sir Astley Cooper, the whole of the small intestine, with the exception of the duodenum, is hidden from view, and occupies a large sac that is formed in the middle of the abdomen, and surrounded by the large intestine.

Sir Astley Cooper described, however, another form of retroperitoneal hernia, to which he gave the name of the mesocolic. In this rupture, the small intestine was contained within a sac that formed a tumour to the left of the middle line, and that had been evidently developed at the expense of the peritoneum leading to the descending colon. There are three significant facts about this form of hernia that require notice. In the first place, the orifice of the sac was some way removed from the duodenal bend; in the next place, the commencement of the jejunum was not involved in the rupture; and thirdly, a branch of the inferior mesenteric artery ran along the free anterior margin of the orifice of the sac.

Now, Treitz and others have endeavoured to show that this form of hernia also is developed from the duodenal fossa. If such were the case, it is hard to understand why the orifice should become so much

displaced, and why the commencement of the jejunum, that is theoretically the first segment of the gut to enter the sac, should be entirely free of it. Treitz and his followers endeavour to explain this mesocolic hernia by asserting that the duodenal plica is often turned to the right, and its fossa to the left. To aid the explanation, they describe certain remarkable arrangements of the "horns" of the plica.

With regard to these statements, which are faithfully repeated in all accounts of these retroperitoneal herniæ, I can only say that I have never found the plica or its fossa turned either to the right or to the left, nor have I ever met with the remarkable arrangements of the fold that have been so carefully described as essential to the production of some varieties of this hernia.

My statement is based upon a careful examination of forty-eight plicæ, of each of which a drawing was made as the parts lay exposed *in situ*. In no instance was the upper margin of the plica other than horizontal, and all the chief deviations from the typical arrangement I have already described. I venture to think that the mesocolic hernia of the type described by Cooper, may be readily explained by a reference to Fig. 5 A, which was taken from the body of a female fœtus at full term. It will here be seen that a deep pouch has been formed in the parietal peritoneum leading to the descending colon, by a branch of the inferior mesenteric artery. The mouth of the pouch is directed upwards.

Such a fossa could readily engage a loop of small intestine, more readily even than the duodenal fossa; and when a retroperitoneal hernia so originating had been fully formed, then the three features that I have already alluded to would be clearly marked; that is to say, the orifice of the sac would be some way from the duodenum, the commencement of the jejunum would not be involved, and a branch of the inferior mesenteric artery would be found skirting the orifice of the sac on its anterior aspect.

Folds and pouches such as this, formed by blood-vessels, would appear to be not uncommon. I have met with two such in the mesentery of two fœtuses at full term. They were in both instances formed by the ileo-colic artery, and in both examples the fold of the serous membrane bounded a not inconsiderable fossa, the mouth of which was directed downwards.

7.—Meckel's Diverticulum.

It may be of interest to note in connection with the frequency with which Meckel's diverticulum is met with in the intestine that I did not find a single example of this offshoot in the hundred specimens examined, nor did I meet with it in any of the fœtuses dissected.

8.—The Mesentery.

The mesentery, so far as its intestinal attachment is concerned, extends, it is needless to say, from the end of the duodenum to the ileo-cæcal junction. Its upper or right layer is continuous with the under layer of the transverse meso-colon, and with the peritoneum that invests the ascending colon. Its lower or left layer joins with the serous membrane that encloses the descending colon, that forms the sigmoid mesentery, and that descends over the lumbo-sacral eminence into the pelvis.

The parietal attachment of the mesentery is liable to considerable variation, and cannot be so readily disposed of. The point at which this attachment commences above is practically constant. It corresponds with the ending of the duodenum, is about on a level with the lower border of the pancreas, and is just to the left of the vertebral bodies. From this point the insertion of the mesentery follows an oblique line that runs downwards and to the right, crossing the great vessels, and then ending in a somewhat uncertain manner in some part of the iliac fossa. The precise manner of its ending will be dealt with subsequently. In an ordinary case, if the mesentery be divided close to the bowel, and all the small intestine be removed, the membrane will appear as a well marked fold, arising by a narrow line from the posterior parietes, and deviating not very considerably from the middle line. It is important to recognise that this attachment does not represent the real root of the mesentery, nor is it any part of the attachment of the median vertical fold of peritoneum that went to the primary intestinal loop. The real

root of the mesentery is in the interval between the transverse colon and the duodenum, where the trunk of the superior mesenteric artery enters.

The lower part of the primary vertical fold is represented by the serous attachments of the descending colon to the parietes. The long line of insertion of the mesentery in the adult is entirely a secondary or acquired attachment. I might recall the fact that there is a time in the history of the development of the intestine when the small intestine, the ascending colon, and the right half of the transverse colon, all form part of a single simple loop, enclosed in a single fold of peritoneum, which is attached to the vertebræ, and has its root in the comparative narrow interval between the transverse colon and the duodenum. At such a time, the parts of the colon named and the small intestine have a mesentery in common. When the rotation of the bowel takes place as already described, when the colon crosses over the duodenum so as to reach the right hypochondriac region, this common mesenteric fold is rotated to the extent of half a circle. Thus it is that what was once the left and under layer of the common mesentery becomes the right and upper layer of the mesentery of the adult, and *vice versâ*.

In time the cæcum descends to reach its final resting-place in the right iliac fossa. As it progresses it outgrows its serous covering, and in time the ascending colon above it acquires a non-peritoneal surface. This part of the large intestine is no longer a part of a free loop, and what is now the permanent mesentery may appear for a while to come off from the parietes, along the inner border of the now attached ascending colon. As a result of further development, the line of origin of the mesentery is moved nearer to the middle line, until it comes to occupy the position that is familiar in the adult. As a matter of fact, the isolation of the permanent mesentery appears before the descent of the cæcum, and it may be seen as a separate fold attached to the spine in the fœtus, when the cæcum still occupies the right hypochondrium (Fig. 8 B). While the cæcum is in this position, the line of the attachment of the mesentery, such as it is, appears to be almost transverse, and it may not attain its permanent oblique direction until the cæcum has reached its goal in the iliac fossa.

In a large number of the mammalia, the ascending colon never

loses any part of its original complete serous investment. It never, therefore, becomes attached to the parietes, but remains as a part of the great loop of intestine, and still invested in a simple mesentery that is common to it and the whole of the jejuno-ileum. In such animals the right limb of the large bowel remains singularly free ; the mesentery of the small intestine retains its primitive relations; it acquires no secondary attachment to the parietes, and its sole root and attachment is in the narrow gap between the transverse colon and the duodenum. This condition is occasionally met with in the human subject. The ascending colon is entirely free up to the hepatic flexure, and is invested by a mesentery, common to it and the small intestine. I have met with two examples of this in one hundred specimens. The condition is of interest pathologically, as favouring the development of a certain form of volvulus of the cæcum and small intestine.

Putting aside this condition, it may be said that the parietal attachment of the mesentery measures, as a rule, about six inches, its mode of ending at its inferior extremity is as follows:—When an ascending meso-colon exists, the mesentery ends by joining it. The two membranes meet at an angle, often at a right angle, and then the right layer of the mesentery becomes continuous with the left layer of the ascending meso-colon, and the left layer of the mesentery with the right one of the colic fold. When no meso-colon exists, the peritoneum that covers the cæcum is reflected from the hinder surface of that part of the bowel on to the posterior parietes; at this reflection the mesentery ends. Its left layer is continuous, and often in a line, with this reflected membrane, and then passes on into the pelvis, while its right layer is continued on to the ascending colon. As the position of this reflection varies considerably, so the length of the parietal attachment of the mesentery must be varied in proportion, and the same applies to cases where an ascending meso-colon exists.

The length of the mesentery from the spine to the intestine varies in different parts of the canal; its average length may be taken as between eight and nine inches. It soon attains its full length, and within one foot of the end of the duodenum is already six inches in length.

The longest part of the mesentery is that which goes to the coils

of intestine that lie between a point six feet from the duodenum, and a point eleven feet from the same part of the gut. Such coils will, therefore, include five feet of the intestine, and the mesentery here not infrequently reaches the length of ten inches. This point is of interest in connection with the position of certain coils of intestine, and to the subject allusion will again be made.

9.—The Mesentery and Hernia.

The important part that the mesentery must play in connection with the commoner forms of hernia has, it would appear, been somewhat overlooked. If the fresh body of an adult be opened, and the condition of the viscera and peritoneum be normal, it will be found that it is impossible to drag a loop of small intestine through the femoral canal (artificially enlarged) on to the thigh, or down the inguinal canal into the scrotum. In fact, no coil can, in any part, be drawn out of the abdomen below a horizontal line on a level with the spine of the pubes. It is evident, therefore, that, in a femoral or scrotal hernia, the mesentery must be elongated. Mr. Birkett, in his well known monograph on Hernia, has drawn attention to this subject, but its importance in connection with the anatomical bases of heredity in some forms of rupture, and with the prospects of operation for radical cure, appears to have been overlooked.

It is not infrequent to find in women, at or past middle life, so loose and long a mesentery as to allow the bowels to be drawn from the abdomen some way below the line named. The same applies, in a less degree, to old subjects of both sexes; but such a condition is quite rare in well developed men in the prime of life. In one old woman, aged 70, the coils of the small intestine could be drawn so far out of the abdomen that they reached, in the middle line, to the level of a point no less than eight inches below the anterior superior iliac spine. She had no hernia. The intestines were normal, but the ascending and descending meso-colons were the most extensive that I had met with. The presence of these latter folds had much to do with the remarkable mobility of the small intestine.

10.—Mesenteric Holes.

Before leaving the mesentery, it is necessary to allude to certain holes that are sometimes found in that membrane, and that have been, on many occasions, the cause of a fatal strangulation of the intestine.

Strangulation of a loop of bowel through a slit or hole in the mesentery, is a recognised form of internal hernia. As to the precise nature of these abnormal apertures, I am not aware that any explanation has been given of their mode of origin. That a certain number are due to violence, and have resulted from injuries applied to the abdomen, there can be no doubt. Such apertures are usually slit-like, and irregular, and of uncertain situation. In the majority of the examples of mesenteric hole, however, this theory of causation cannot apply: there is either an absence of any history of violence, or a history of inadequate violence.

When I came to examine all the museum specimens to which I had access, and the accounts furnished in recorded cases of strangulation through a mesenteric hole, I found that the great majority of these abnormal gaps in the membrane presented the following common characters. The holes were round; they were situated in the mesentery of the terminal part of the ileum; their margins were distinct, being often thickened and opaque, and around a part of the margin it was not uncommon to find one of the terminal branches of the superior mesenteric artery. A systematic examination of the lower part of the mesentery, in a large series of cases, brought to light the following facts. In the fœtus it will often be observed that the ileo-colic branch of the superior mesenteric artery circumscribes, by its anastomosis with the last of the intestinal arteries, an area on the mesentery, of a well-rounded or oval shape (*a* Fig. 13 G). This area is remarkable, in so far that it presents no fat, no visible blood-vessels of any kind, even in well-injected specimens, and is never occupied by any mesenteric glands. An area so differentiated from the surrounding mesentery I have seen in fœtuses of six and seven inches in length; but although a common, it is not a constant condition. In many bodies

beyond the period of fœtal life, I have met with this singular and isolated area in the mesentery still retaining the characters just described, and rendered conspicuous by its thinness and bloodlessness.

In the fœtus at full term, and in children under puberty, it is usually about the size of a shilling-piece. The margins of the district are marked by the arteries named, and are occasionally rendered more pronounced by some opacity of the membrane. It will be seen that this area has the precise situation, the outline, and the dimensions of the mysterious mesenteric hole; and by the atrophy of the peritoneum occupying the district such a hole would be formed.

I was fortunate enough to meet with a specimen that I venture to think will complete the argument that the common mesenteric hole is produced by atrophy of this particular patch in the peritoneum. In the body of a man aged 52, I found the area in the mesentery that I have just described very pronounced. It formed a patch of oval outline measuring $1\frac{3}{4}$ by $1\frac{1}{4}$ inches. It was entirely devoid of visible vessels, of glands, and of fat; while the adjacent mesentery was quite opaque from adipose tissue. The margin of the space was markedly opaque, thickened and abrupt, and was skirted on the side nearest the cæcum by one of the terminal branches of the superior mesenteric artery. The serous membrane that formed this area was remarkably thin, clear, and atrophied. The atrophy was of such a degree that the little patch of peritoneum was cribriform, being pierced by about twenty holes. It is evident that but a slight degree of force would have been required to have thrust a knuckle of bowel through this wasted membrane, and so have produced a strangulation of the bowel through a "mesenteric hole."

In one specimen—in a male fœtus at full term—where this peculiar oasis in the mesentery was well defined, the last intestinal artery had produced a fold at the cæcal margin of the patch (*b* Fig. 13 G). By this means a pocket was formed, which would have been a ready snare for a wandering loop of bowel, and would have directed such a loop through the thinned serous membrane.

11.—The Arrangement of the Small Intestine.

In the one hundred specimens examined, I took great pains to ascertain if the small intestine followed a constant course, and if there were anything like a method in the arrangement of the individual coils. In each instance, when I had opened the abdomen, and before any of the parts had been disturbed, I affixed a brass number to every visible coil of small intestine. A drawing was then made of the parts as they lay *in situ*, and the position of each of the numbers subsequently ascertained by noting its distance from the commencement of the small intestine. The work was very laborious, and the results very scanty. I had some faint hope that an extensive examination of this character would enable the surgeon to form a notion of the part of the small intestine that would be likely to be involved in the various herniæ on different sides of the body.

The investigation, however, showed that such a localisation is quite impossible. Apart from this, the intestinal coils conform in some degree to a definite arrangement in a large number of cases. If the body of a fœtus about five or six inches in length be examined, the cæcum will be found in the right hypochondrium ; and, with little or no displacement of parts, the small intestine will be seen to be arranged along a curved line that is convex downwards, that is almost transverse, and that extends from the left side to a corresponding point on the right side (Fig. 8 A). This arrangement can still be followed out, although in a less definite manner, in a fœtus at full term (Fig. 9). In both these diagrams, the numbers on the coils represent the order from the duodenum to the cæcum.

In children, moreover, up to two or three years of age, the same general arrangement can often be followed out.

In the majority of adult bodies, the small intestine is disposed in an irregularly curved manner from left to right. The gut, starting from the duodenum, will first occupy the contiguous parts of the left side of the epigastric and umbilical regions ; the coils then fill some part of the left hypochondriac and lumbar regions ; they now commonly descend

into the pelvis, reappear in the left iliac quarter, and then occupy in order the hypogastric, lower umbilical, right lumbar, and right iliac regions. Before reaching the latter situation, they commonly descend again into the pelvis.

In the specimen from which Fig. 10 B was taken, this order was very fairly observed. The body was that of an adult male, aged 25. As a rule, however, the position of the individual coils is much less regular, and the arrangement depicted in Fig. 10 A (also from an adult body) shows very plainly the extent of the irregularity.

The following facts will demonstrate the gross deviations that may be found from what may be regarded as the typical disposition of the intestinal coils. In the left lumbar region, loops may be met with that are respectively a few inches on the one hand and 15 feet on the other from the duodenum. In the left iliac quarter, the extremes are 2 feet and 23 feet; in the hypogastric, 11 feet and 26 feet; and in the right iliac, 9 feet and 28 feet. In one case, I found that a coil situated in contact with the middle of Poupart's ligament on the left side was only 11 inches from the end of the duodenum; and in another, a loop that was lying against the bladder in the middle line was only 2 feet from the same point. All these observations refer to the adult body.

It is to be noted that in the fœtus, and during the earliest part of extra-uterine life, the bulk of the small intestine is placed to the left of the middle line. This is on account of the relatively large size of the liver, to the weight of which the lesser bowel no doubt acts as a counterpoise. Such disposition of the intestine is not to be clearly observed in the adult; but I am under the impression that, if a vertical antero-posterior section of a frozen body were made, it would be found that the heavier segment of the small intestine lay to the left of the median line.

In five instances among the hundred specimens examined, the coils of the small intestine were arranged in a manner exactly the reverse to that usually found. In each example, the end of the duodenum was to the left of the middle line as usual, and the other abdominal viscera were normal as regards their general arrangement. Starting from the fixed point to the left of the spine, the intestine at once passed to the right, occupied the lower margin of the right hypochondrium, and then,

in order, the right lumbar and iliac regions. The gut now descended into the pelvis, and then was found forming coils about the middle of the abdomen, and in the left iliac and left lumbar regions. In the latter district the lower end of the ileum was discovered, and it was observed to sweep across the abdomen from left to right, behind the other coils, to end in the cæcum. Three of the subjects were females, of the ages respectively of 3, 17, and 36 years. The two others were males, and both of 6 years of age. From one of the latter the Fig. 11 B has been taken. The numbers indicate the order pursued from the duodenum. The whole length of the intestine measured 15 feet, and coil No. 13 was found to be 14 feet from the commencement of the bowel. In all these instances, the parietal attachment of the mesentery was normal, and followed a line directed from left to right. After its origin, the membrane took an extensive sweep to the right, and more intestine appeared to be clustered about the lower part of the mesentery than is usual. In three instances, the cæcum was large and mobile, and extended some way to the left of the middle line. In the two remaining cases, the cæcum was normal. In all the specimens the relation of the serous membrane to the colon was as usual. In other cases, in which the cæcum was displaced to the left, as in the three instances cited, the arrangement of the small intestine was found to be undisturbed. The cause of the deviation in the present examples must remain at present unexplained. It was too precise to be purely accidental.

12.—The Coils of Intestine that occupy the Pelvis.

A good deal of interest attaches to the coils of small intestine that are found in the pelvis. These are the coils that are apt to become involved and adherent in cases of pelvic peritonitis, and that would probably form the protrusion in most instances of obturator, sciatic, and pudendal hernia. In the fœtus, owing to the small size of the pelvic cavity and the great development of the sigmoid flexure, no coils of small bowel are found below the true pelvic brim. Soon after birth, however, the pelvis begins to accommodate intestinal coils, and in the

body of a child, aged four months, I found three feet of the lower ileum occupying the pelvis. The amount of the intestine found in the adult pelvis depends mainly upon the state of distension of the bladder and rectum, and upon the position of the sigmoid flexure. When the latter loop or the cæcum is distended and occupies the pelvis, all small intestine may be excluded.

The coils that are most usually found in this position belong to the terminal part of the ileum, and to that part of the intestine that has the longest mesentery, the part, namely, that extends between two points, respectively 6 and 11 feet from the end of the duodenum. It is not, therefore, uncommon to find loops lying together in contact with the pelvic floor that are in reality some 12 or 14 feet apart, as may be seen when their proper position in the course of the bowel is defined.

I think this matter is deserving of attention, because it is not uncommonly assumed that the coils occupying the pelvis belong exclusively to the lower ileum, and anatomical text-books would not lead one to believe that jejunum is ever found in the pelvic cavity. The amount of small intestine that may be found in the pelvis, even in bodies that have been opened within a short while of death, is often considerable, and frequently measures 8 or 10 feet.

In the case of a woman, aged 82, the whole of the small intestine was found in the pelvis, with the exception of the first three feet of the jejunum, and the last two feet of the ileum.

The specimen, however, from which Fig. 11 A, was taken, illustrates, in the most remarkable manner, the possible capacity of the pelvis. The subject was a woman, aged 59, who had died with cancer of the pylorus. When the abdomen was opened, nothing was seen but the stomach and a small part of the transverse colon, the latter projecting just above the symphysis. The whole of the small intestine beyond the duodenum was found entirely within the true pelvis, with the sole exception of the first twenty inches of the jejunum. This part of the tube descended quite vertically along the spine from the duodeno-jejunal junction to the pelvis. The small intestine, which had been emptied by starvation, measured 23 feet.

In more than one instance where there has been deformity or great distension of the transverse colon, I have found the whole of the small

intestine, with the exception of the duodenum and the commencement of the jejunum, below a line drawn on a level with the summit of the iliac crest.

15.—The Cæcum:—The four Types of Cæcum.

In shape and outline, the cæcum is liable to considerable variations. These variations, however, can be readily classified, and I shall endeavour to show that all forms of the cæcum can be placed under one of four common types.

The particular outline of the human cæcum, and the nature of the deviations that it may present, can be best demonstrated by a reference to the development and early condition of this part of the colon. The cæcum appears first as a simple conical projection from one side of the intestinal loop. The projection is short, and is broad at the base. It may be considered to be permanently represented in anatomy by the cæcum of the Mangabey monkey (Fig. 15 A). It soon grows in length, but this growth is not attended by a corresponding development in breadth; so that it next appears as a long tube of equal width in all parts, except at its base, where it widens out before it joins the rest of the bowel. This stage is permanently represented by the cæca of many animals, and as a good example may be selected the cæcum of the Spider monkey (Fig. 14 D). As development advances, the greater part of the tube practically ceases to grow, while active increase continues in the still widened part of the bowel at the base of the projection. In time, a long narrow tube is found hanging from the apex of a conical projection or diverticulum of the bowel; the latter is named the cæcum, and the tube the vermiform appendix.

This condition may be taken as typical in man of the fœtal cæcum, and it forms the *first* of the four common types of cæcum to which allusion has just been made (Fig. 12 A). If the typical fœtal cæcum be examined, it will be seen to be conical in shape; from its apex the appendix arises, and this apex is about in a line with the long axis of the colon, and corresponds very nearly to the centre of that intestine. Now, from the colon, three longitudinal muscular bands descend to the

cæcum. The exact position of these bands and their relation to the outline of the cæcum have been very ably detailed by Professor Flower. The three bands meet at the apex of the cæcum, that is, at the root of the appendix; one band lies on the side of the bowel into which the ileum enters; a second is placed upon the postero-external aspect of the colon and cæcum; whilst the third, and the most distinct, runs along the anterior aspect of the gut. The last named band about corresponds to the central vertical axis of the ascending colon. In the fœtal cæcum, these three bands are placed at nearly equal distances from one another, and so divide the caput coli into three fairly equal parts.

The first or fœtal type of cæcum may persist throughout life. In one hundred bodies, I found two examples of such persistence. Both the subjects were females, of the ages respectively of 50 and 70 years (Fig. 12 B).

In the *second* type of cæcum (Fig. 12 C), the three bands retain their relative positions. If the part be viewed from in front, there is an equal extent of gut on each side of the anterior band; the apex of the cæcum retains its original position, and this type differs only from the last described by the loss of the conical outline and the substitution of a more quadrilateral shape. The apex appears between two bulging sacculi, instead of at the summit of a cone, and it will be seen that all parts of the caput have developed to an equal degree. This would appear to be the form of cæcum that is usually met with in the anthropoid apes. I found a good example of it in a Silvery Gibbon (Fig. 15 C). It is rare in the human subject, and I met with only three instances among the hundred specimens examined.

In the cæcum of the *third* type, that part of the caput coli that lies to the right side of the anterior band grows quite out of proportion to the part placed to the left side of the band, as the bowel appears when viewed *in situ*. Moreover, the anterior wall of the cæcum becomes more developed than the posterior wall. As a result, the true apex of the cæcum is turned more and more to the left, until at last it is placed in close proximity to the ileo-cæcal junction, and can be only recognised by noting the point of origin of the appendix. The highly developed part to the right of the anterior band becomes so dependent and prominent, that it forms a new or false apex to the cæcum and it is,

indeed, to this projection that the anatomical term "apex" is usually applied. Moreover, from the undue development of the anterior wall, the root of the appendix (the true apex) is carried towards the posterior aspect of the caput, and by these changes the cæcum of the third type is produced (Fig. 13 E). This form is the most usual one, and represents the condition of the cæcum in the great majority of all subjects beyond the period of fœtal life.

It appears to me that the transformation described depends to a great extent upon the arrangement of the blood-vessels. The cæcum is supplied by the ileo-colic artery. This vessel is directed towards the ileo-cæcal junction. Before it reaches the bowel, it divides into two branches. One passes to the anterior aspect of the gut, and runs down the cæcum in a curve, with the concavity towards the ileum, until it reaches the anterior band upon which it ends. Many branches come off from the convexity of this little trunk, but no visible arteries of any magnitude (and often none at all) come off from its concave side. It results, therefore, that the main part of the blood carried by the trunk will reach that part of the cæcum that is to the right of the anterior band, while but a fractional part will go to the wall of the caput to the left of the band. It may not be unreasonable, therefore, to associate this unequal blood-supply with the very unequal growth that is observed upon the two sides of the band. In animals with more equally developed cæca, it will be seen that the blood-supply is also equable, a fact well illustrated in the cæca of the Mangabey and Spider monkeys. The other branch of the ileo-colic trunk proceeds to the posterior aspect of the gut; but, although of larger size than its colleague, comparatively little of the blood that it carries can reach the cæcum, since it runs in the mesentery of the appendix. This may serve to explain the greater development of the anterior wall of the cæcum, when compared with the posterior part.

In the cæcum of the *fourth* type, the development of the part of the bowel to the right of the anterior band is excessive, while the segment to the left of the band has atrophied, and is more or less wanting (Fig. 12 D). In this form, the anterior band runs to the inferior angle of junction of the ileum with the cæcum. The root of the appendix is posterior to that angle. There is no trace of the

original apex, and the appendix appears to spring almost from the ileo-cæcal junction. I have met with five examples of this type. In four instances, the subject was an adult; while, in the fifth case, the specimen was obtained from a fœtus at full term.

In venturing to propose this classification of cæca under four types, I might mention that I have as yet met with no form of cæcum that could not be placed in one or other of these four divisions.

14.—Unusual Cæca.

It is needless to say that, apart from its outline, the cæcum presents variations in its general development. In some instances, the part is small and insignificant; while, in other instances, it may attain remarkable proportions. As an example of the latter condition may be taken the cæcum represented in Fig. 13 F. It was from the body of a man aged 65, whose abdominal viscera were all healthy. The cæcum, and the part of the ascending colon immediately above it, were free, and entirely enveloped in peritoneum to the extent of eight inches. The caput coli was found turned upside down, so that its apex pointed upwards, and the ileum entered it on the right side. This great cæcum projected some way to the left of the middle line, and its summit was not far below the liver. It was so mobile that its apex could be made to touch a point on the front of the thigh, six inches below the anterior superior iliac spine. In the diagram, the parts are represented as they appeared *in situ*.

In another peculiar specimen, from a man aged 48, I found the cæcum rotated to the right around its vertical axis. The rotation was such that the ileum passed behind the cæcum to enter it on its right side. The anterior band also inclined to the right border, and, from the same aspect the appendix arose. The cæcum was free, and entirely invested by peritoneum; it was held down by no fold; there were no traces of peritonitis; and the twist, which in no way affected the lumen of the bowel, could not be unfolded. I imagine that the condition must have been due to an unequal development of the component parts of the gut. The colon was perfectly normal.

In another instance, the posterior part of the cæcum was much more developed than was the anterior part; with the result that the ileum entered the large intestine from the front, and the appendix vermiformis came off from the anterior wall of the caput coli.

15.—Dimensions of the Cæcum.

With regard to the dimensions of the cæcum, it is necessary, before they can be given, that the limits of this segment of the gut be clearly laid down. The cæcum is defined as that part of the colon which is situated below the entrance of the ileum. The breadth of this part, therefore, may be represented by a line drawn transversely across the bowel, at the level of the lower border of the ileum, at the ileo-cæcal junction. The length may then be expressed by a vertical line drawn from the line just named to the apex or lowest point of the cæcum. From careful measurements, made of a large number of adult cæca, I find that the average breadth of this part is three inches, and the average length two and a quarter inches. The largest cæcum that I met with had a diameter of four inches. The smallest (from the body of a well developed woman, aged 36) measured only three-quarters of an inch in length, and one and a half inches in breadth. It is exceptional to find a cæcum with both its diameters equal.

16.—Relations of the Cæcum.

It will now be convenient to consider the relations and connections of the cæcum; and here I might at once state that the result of my investigations upon this point is entirely at variance with the statements contained in the anatomical text-books. The account given of the cæcum in works on anatomy would appear to be very ancient. It can be traced back, from book to book, through many literary generations; and, throughout its long history, it seems to have undergone little or no alteration. It is one of these descriptions that forms a real anatomical property, and that descends from one author to another with the precision of entail.

The following is the account of the caput coli that is given in the last edition of Quain's *Anatomy*, a book that very justly holds the proud position of being the best work on Anatomy extant. "The intestinum cæcum, or caput cæcum coli, is that part of the large intestine which is situated below the entrance of the ileum.... The cæcum is situated in the right iliac fossa immediately behind the anterior wall of the abdomen. It is covered by the peritoneum in front, below, and at the sides; but behind it is usually destitute of peritoneal covering, and is attached by areolar tissue to the fascia covering the right iliacus muscle. In this case, the cæcum is comparatively fixed; but in other instances the peritoneum surrounds it almost entirely, and forms a duplicature behind it, called meso-cæcum." Accepting the definition of the cæcum given by the editors of "Quain," and by all other anatomists, I might state that, in the one hundred specimens examined, I have never found the posterior surface of the cæcum uncovered by peritoneum; I have never found it attached by areolar tissue to the iliac fascia; and I have not met with one single example of a meso-cæcum. I am very much disposed to doubt the existence of such a fold as the last named.

When the abdomen is opened shortly after death, while the rigor mortis is still present, and before the intestines have become distended by the gases of decomposition and so displaced, it will be found that the cæcum is usually lying upon the psoas muscle, and so placed that its apex or lowest point is just projecting beyond the inner border of that muscle. In such a case, the cæcum will often be nowhere in relation with the iliacus muscle, or only its upper limits will be in contact with that structure. In defining these relations, it is essential not to lose sight of the precise definition of the caput coli. Less frequently, the cæcum will be found to be in relation with the iliacus muscle only, or the bulk of the caput will lie upon that muscle, while the apex rests upon the psoas.

In the great majority of instances, the apex of the cæcum corresponds with a point a little to the inner side of the middle of Poupart's ligament.

In a number of cases, the cæcum is entirely clear of both psoas and iliacus muscle, and hangs over the pelvic brim, or is lodged entirely

within the pelvic cavity. In eighteen instances, I have found the cæcum in this latter situation lying sometimes directly upon the pelvic floor, or placed in contact with the upper surface of the bladder or uterus, or wedged in with the sigmoid flexure, or lying actually in contact with the left wall of the pelvic basin. It cannot be said to be exceedingly unusual to find that some part of the cæcum has just passed to the left of the median line of the body.

Now in every instance that I have as yet seen, the cæcum has been entirely enveloped on all sides by peritoneum, and has been free in the abdominal cavity.

The line of reflection of the peritoneum from the posterior wall of the cæcum on to the posterior abdominal parietes varies somewhat. When an ascending meso-colon exists, this reflection will coincide with the origin of such meso-colon. In any case, it is continuous with the left or under layer of the mesentery. The reflection is usually transverse, and is commonly placed between a line on a level with the summit of the iliac crest and another on a level with the anterior superior iliac spine. It is as a rule limited to the surface of the psoas muscle, or to that muscle and a small part of the adjoining part of the iliacus. In a few instances, the reflection has coincided with the latter muscle only. The line of the reflection may in a smaller series of cases be oblique. In such instances, it may follow the inner border of the psoas muscle, or cross the surface of that muscle, or correspond to its outer margin. In one specimen the line of reflection was transverse, and corresponded to the lower margin of the kidney.

Now, in the great majority of all these cases, the reflection in reality takes place from the posterior surface of the ascending colon, and not from the cæcum, so that not only is the cæcum entirely covered by serous membrane behind, as well as on all other sides, but the same complete covering is bestowed upon the commencement of the ascending colon. Those who are impressed with the orthodox description of the cæcum will scarcely believe that the average measurement in a vertical line along the back of the colon, from the tip of the cæcum to this reflection of peritoneum is four inches. If from this be deducted $2\frac{1}{4}$ inches for the average length of the cæcum, it leaves $1\frac{3}{4}$ inches of the ascending colon entirely invested on all sides by peritoneum. As the

line of reflection is not above the level of the iliac crest, it follows that the part of the colon so invested will lie below that level. In the case of the cæcum depicted in Fig. 13 F, the reflection of serous membrane from the posterior surface of the bowel was along the pelvic brim, and from this reflection to the tip of the cæcum the bowel measured eight inches. I have excluded such exceptional cases from the above average.

With the rare cases in which the ascending colon has no connection at all with the posterior abdominal parietes, I will deal when speaking of the ascending meso-colon.

The relations of the cæcum to the peritoneum are of great interest in surgery and medicine, the part being so frequently the seat of trouble. It has, I notice, been recently proposed that, in certain inflammatory conditions of the cæcum, the gut be reached by an incision from the loin, the incision not to include the peritoneum, but the gut to be exposed at its hinder part, just as the external iliac artery is exposed in the extra-peritoneal operation for ligature. I would take the liberty of stating that such a procedure is anatomically impossible. With regard to the mysterious meso-cæcum, it is probable that that term has been applied to the lowest part of the ascending meso-colon, the limits of the cæcum having been ignored when the nomenclature was evolved.

The mobility of the cæcum is often considerable, and depends in the main upon two conditions—either upon the length of intestine that extends between the tip of the cæcum and the reflection of the peritoneum above alluded to, or upon the presence of an ascending meso-colon. The former factor is of greater moment than the latter. In eleven bodies I have met with cæca that could be made to touch the under surface of the liver, and any part of the left side of the pelvis. In some of these specimens, the cæcum might very well have occupied an inguinal or femoral hernia on the left side, had the hernial orifice been large enough. In one case the tip of the cæcum could be made to touch the xiphoid cartilage, and in several instances the mobile piece of intestine could be drawn down the thigh to the level of the great trochanter.

17.—The Ending of the Ileum.

As a rule the ileum ascends to enter the cæcum, but in certain cases it descends to its termination, especially in those cases in which the order of the intestinal coils is found to be reversed.

In not a few specimens the terminal part of the small intestine has been closely attached to the psoas muscle, not by direct adhesion but by means of a fold of peritoneum that has passed from the left or under layer of the mesentery to the serous membrane covering that muscle.

In some five instances I have found the last inch or last few inches of the ileum closely adherent to the cæcum. Such adhesion has been brought about by a certain readjustment of parts, and is quite independent of any pathological change. A good example is afforded in Fig. 16 C. Here the ileum, having crossed the psoas, reached the line at which the peritoneum was reflected from the posterior surface of the colon. At this point (M) the gut became suddenly bent upon itself, and ran vertically downwards along the back of the ascending colon and cæcum, to end at about the usual position (N). The segment of bowel between the points M and N measured four inches, and was closely adherent to the colic wall. This specimen may be taken as a fair type of the condition of things, when the terminal part of the ileum is adherent.

18—The Appendix and its Mesentery.

In spite of its insignificant size and its very slight physiological importance, there is centred about the vermiform appendix peculiar anatomical interest.

In the adult, the average length of the appendix is four inches, the extremes being one inch on the one hand, and six inches on the other. The growth of the appendix would appear to be irregular and uncertain, and to be influenced in no way by the development of the main intestinal tube. It would seem that it may attain to its full length quite early in life, and I have met with an appendix four and three-quarter

inches in length in the body of a child aged three years. The width of this process is more constant, and is, indeed, liable to very few fluctuations. In one remarkable case, in a male subject 37 years of age, I found the appendix to be four inches in length, and a little over half an inch in width. This extraordinary transverse diameter it retained up to its very extremity. The process was unprovided with a mesentery, and was attached vertically to the posterior aspect of the cæcum and colon.

In three subjects, amongst the one hundred examined, examples were afforded of practical obliteration of the appendix. In each instance, the body was that of a male adult. In each, the cæcum was found bound down by old peritoneal adhesions, due to a past peri-typhlitis, and buried in these adhesions the appendix was discovered. It appeared as a white tough fibrous cord, between one and one and a half inches in length, and about the size of a No. 9 catheter. It was placed vertically behind the cæcum, and had no trace of a mesentery. In one specimen, no canal could be detected in the cord, and no opening into the bowel made out; but, in the other instances, a patent canal was discovered that would just lodge a pin. Such specimens may be of interest in connection with the question as to whether the appendix has a function, or is functionless.

Appendices, under the length of three inches, may appear as quite straight tubes when processes so short are met with in the adult. In the great majority of instances, however, the appendix is much twisted upon itself. Its spiral form depends mainly upon the shortness of its mesentery. When the tube is untwisted—a measure that will usually involve some division of its mesentery—it most commonly forms a fairly regular curve, with the concavity towards the cæcum. This curve will carry the appendix behind the cæcum, and it will be usually found to continue the direction of the curve formed by the anterior muscular band.

In more than one specimen, I have found the process sharply bent upon itself at its extremity, so as to form a species of hook. In the fœtus, the process is commonly curled up at the posterior and inferior aspect of the cæcum.

In the majority of cases in the adult body, the appendix—when

examined *in situ*—will be seen to lie behind the end of the ileum and its mesentery, and to point in the direction of the spleen. In the only other position that may be said to be at all common, the little tube ascends vertically behind the cæcum. This position nearly always depends upon an abnormality in the arrangement of the appendix mesentery, to which allusion will be subsequently made. In four instances where the appendix was so placed, the tip of the process was very near to, if not in actual contact with, the under surface of the liver; and, in one of the four specimens, it was found touching the gall-bladder.

In these cases, and in several other instances where the appendix ran vertically behind the cæcum, the process would have been encountered in performing a right lumbar colotomy.

When the cæcum occupies the pelvis, the appendix, of course, lies with it; but, in one or two specimens in which the cæcum occupied its normal position, the process was found hanging down into the pelvis. In one body—that of a male aged 10—the caput coli was strictly limited to the iliac fossa, but the appendix—which measured $4\frac{1}{2}$ inches—was lying in the pelvis, and in contact with the bladder.

The strangest position assumed by this little tube was met with in the body of a woman aged 33. In this subject, the appendix was straight, measured nearly five inches, and had an extensive mesentery. It passed horizontally across the middle line in front of the lumbo-sacral eminence, so that its tip rested upon the left psoas muscle.

In one case, I found the tip of the process adherent to the left layer of the mesentery of the ileum in such a way that a loop was formed, beneath which a coil of bowel might readily have become strangulated. This was the only instance noted, in the hundred cases, of an appendicular loop.

The *mesentery* of the appendix is formed by a very definite fold of the serous membrane. It comes off from the left, or under layer, of the mesentery of the end of the ileum. Its origin from this layer is along a straight line, which is situated at a short distance from the intestine, and which is not quite parallel with the margin of the bowel. If the appendix be pulled away from the cæcum, so that its mesentery is fully displayed, it will appear to come off at right angles from the enteric mesentery. At one extremity, this little fold runs right up to the ileo-

cæcal junction, while, at the other end, it forms a free and concave margin. In its general outline it is triangular (Fig. 14 A). In the fœtus it may extend to the tip of the appendix, but in the adult, it often only reaches to the centre of the tube, or to the junction of its middle with its distal third. It is too short for the appendix, and this disproportion between the process and its serous fold accounts for the twisted condition of the former. In the free margin of this little mesentery there runs an artery, a branch of the ileo-colic. From this artery, at regular intervals, are given off branches to the appendix. The earliest and largest of these reaches the posterior wall of the cæcum.

Now, in eighteen per cent. of the bodies examined, it was found that the appendix, instead of being placed obliquely, as already described, ascended vertically behind the cæcum. In such cases, the process was often straight, or curved only at its extremity, and it was found that the mesentery of the appendix had unusual connections. These connections are susceptible of a ready explanation.

It has been already pointed out that the bowel grows out of proportion to the peritoneum that covers it, and this disproportion is especially to be noticed in connection with the colon. The instances of displacement of the mesentery of the appendix are to be explained upon the assumption that the relation between the growth of the cæcum and the serous membrane about it has been more conspicuously disturbed than usual.

As the cæcum grows under the almost passive peritoneum, it tends to encroach upon it, and to clothe itself with such parts of the serous membrane as are in its immediate vicinity. It approaches the mesentery of the ileum, and takes some part of that layer upon its walls. With the mesentery goes also the mesentery of the appendix, and in one class of case the latter fold will be seen to arise in part from its usual site, and in part from the posterior wall of the cæcum. At the same time the direction of the growth of the cæcum will have rendered the little mesentery more vertical (Fig. 16 A). If this disproportionate growth continue, it will be found that the appendix mesentery has become quite vertical, has attachment to the cæcum only, and has been rendered much scantier by the encroachment of that part of the bowel. Such a condition is presented by the specimen from which Fig. 16 B was drawn.

Taking another step in the same direction, the little mesentery will be found to have been so much unfolded by the growing cæcum, that it is still further reduced, while, near the root of the appendix, it has disappeared, and that process is actually adherent to the caput coli (Fig. 16 c).

In a more advanced degree of the same condition, the appendix is almost wholly adherent to the cæcum, while its mesentery is reduced to the scantiest proportions. This is illustrated by Fig. 16 D, from the body of a man aged 33. In the last stage of all the appendix has no mesentery at all, but is adherent, in a vertical line, to the posterior wall of the cæcum, its extremity, being as a rule, however, free. These variations, in their different stages, have all been illustrated by examples provided by the one hundred bodies examined.

The account of the mesentery of the appendix may be completed by observing that in rare instances a fold of peritoneum has passed from that margin of the process most remote from its mesenteric border, to join the serous membrane at the pelvic brim. This has only been noticed in instances where the appendicular fold took its normal origin from the mesentery of the ileum.

19.—The Ileo-Cæcal Fossæ.

About the cæcum, and especially in the vicinity of the ileo-cæcal junction, are certain fossæ collectively known as the ileo-cæcal. They possess not only considerable anatomical interest, but are also worthy of notice as having been the reputed seat of certain herniæ, some of which have been the subjects of strangulation. They have attracted the attention of certain anatomists, and notably of Luschka, Hartmann, Treitz, and Waldeyer.

I might be allowed to say that the accounts given of these pouches are somewhat involved, are frequently contradictory, and, I might venture to add, are also incorrect. Certain fossæ are described as constant, that would appear to be exceedingly rare. The subject has suffered also from a reckless and exuberant nomenclature; and one little fossa, termed indiscriminately the fossa ileo-cæcalis infima, the fossa

subcæcalis, and the recessus retro-appendicularis, I have entirely failed to discover. I should be sorry if these were regarded as sweeping assertions, but they are founded upon a careful systematic examination of the parts in one hundred fresh bodies, a drawing of the involved regions having been made on the spot in each instance.

Describing these fossæ as they are met with, it will be found that there are only two that can be said to be in any way constant. The ileo-colic artery, when it nears the cæcum, divides into two branches; one of these, passing behind the ileum, appears as the vessel that runs along the free margin of the mesentery of the appendix; the other branch crosses the front of the ileo-cæcal junction, and ends almost immediately upon the anterior surface of the cæcum. It is concave towards the small intestine, and gives off several branches to the caput coli from its convex border. In its passage across the line of junction between the cæcum and the ileum, the artery produces a fold in the peritoneum. This fold covers the ileo-cæcal union, is concave at its free edge, and limits a fossa. This small pouch may be well termed *the superior ileo-cæcal.* It is not always present, it often forms but a slight fossa, and the largest pouch that I have met with in this situation took the point of the thumb to a depth sufficient to cover the nail. It is shown in the diagram of the cæcum of the Mangabey monkey (Fig. 15 A), and with this pouch the fossa in the human subject is practically identical. It is difficult to understand that it can ever be the seat of a hernia.

The second fossa is not quite so simple. If the cæcum be turned upwards, so as to expose its posterior surface as it lies *in situ*, and it the appendix be drawn down so as to put its mesentery on the stretch, a peculiar fold will be found to join that mesentery (Fig. 14 A). This fold, which may be of considerable dimensions, arises from that border of the ileum that is most remote from the insertion of its mesentery. It then passes over the ileo-cæcal junction on its inferior aspect; is adherent to the cæcum, and finally joins the surface of the mesentery of the appendix. Its line of attachment to the appendix mesentery forms an acute angle with the little tube itself, and seldom extends over more than one-half of the membrane.

The connection of this fold to the ileum often extends to the

length of one and a half inches. The plica in question is distinguished from the other folds in the vicinity by its bloodlessness. Even in well injected specimens, it may not present any visible vessels. If it do present any arteries, then they will still be very small, and will be derived from the vessel that runs in the free margin of the mesentery of the appendix. For convenience of description, and until some name is devised, it may be called the bloodless fold. Between this fold and the appendix mesentery there is a fossa that is almost constant, and is often very capacious. It will commonly lodge two fingers as far as the first joints. It opens outwards, its apex is at the ileo-cæcal junction, and it is bounded on one side by the small intestine, and on the other by the caput coli. To this conspicuous pouch may be applied the name of the *inferior ileo-cæcal fossa.*

These are the only constant fossæ that are met with in this region. They may be observed in subjects of all ages, in the fœtus at full term, and even at an early period of intra-uterine life. I have found them both well marked in fœtuses that measured respectively five and a half and four and a half inches in length.

20.—The Formation of the Ileo-cæcal Fossæ.

In connection with these fossæ, the greatest interest attaches to the bloodless fold. An examination of embryos that displayed the earlier stages of the development of the intestine afforded no certain clue as to the nature and origin of this singular membrane. A very full explanation, however, of its significance was at once afforded by an examination of the parts in the lower animals.

Regarded from the standpoint of comparative anatomy, objection may be taken to the practice of regarding the appendix vermiformis as something that is distinct from the cæcum. This process is simply an undeveloped cæcum, a cæcum of which only the proximal end has grown in proportion with the growth of the body. If the appendix in the human subject could be distendeduntil it was nearly of the size of the caput coli, then the whole diverticulum would closely resemble the cæca of many of the mammalia. If, on the other hand, in a long

mammalian cæcum, such as that of the Kangaroo (Fig. 14 B), the distal part had not developed in proportion with the rest, then would a cæcum and appendix be produced that would compare with like named parts in the human subject. It is well, therefore, to hold in mind that the simple cæca of most of the lower animals represent both the cæcum and the appendix of the highest mammal.

In such animals as have a prominent cæcum, it will be noticed that a well-marked fold of peritoneum passes to it from the ileum. The subject may be here simplified by selecting the cæcum of some one animal (and I have arbitrarily selected the Kangaroo) as a basis for the description of this very general fold. The fold always passes from that margin of the ileum that is most remote from the attachment of the mesentery to that border of the cæcum that is nearest to the small intestine (Fig. 14 B and C). It is a thin layer of peritoneum, with a well defined concave margin, and is singularly free from visible blood-vessels. It is the true mesentery of the cæcum ; it is continuous over the ileum with the mesentery of that bowel ; and it is evident that it has been derived from the latter membrane by the budding out and subsequent growth of the caput coli. As this diverticulum has developed, it has carried a part of the common serous investment of the intestine with it. It has nothing to do with conveying blood to the cæcum.

This part of the bowel is supplied by the ileo-colic branch of the superior mesenteric artery. This vessel, on nearing the gut, divides into two branches—one small, the other large. The former crosses the ileo-cæcal junction on its anterior aspect, while the latter occupies an almost corresponding position on the posterior surface of the bowel. As they run to their destinations, these arteries draw the adjacent peritoneum into folds, and near the free margins of these folds the arteries will be seen.

The fold for the anterior artery is usually small, and covers the ileo-cæcal junction ; while that for the posterior vessel is more extensive, and runs from the left or under layer of the mesentery of the ileum to join the mesentery of the cæcum. As may be expected, variations are met with in these folds in different animals ; but such variations are slight, and the general arrangement of these processes of the serous

membrane would appear to be singularly constant. In the Mangabey Monkey, where the cæcum is very short, the disposition of these folds is precisely the same as it is in the long cæcum of the Kangaroo (Fig. 15 A and B). In the Spider Monkey, there is a symmetry in the arrangement of the cæcal plicæ. The true mesentery of the cæcum is placed in the middle of the bowel, while on each side the anterior and posterior vascular folds run in a perfectly symmetrical manner. In this specimen, it will be seen that the two last named folds are of equal size (Fig. 14 D).

Now, on turning to the human cæcum, it will be seen that the anterior vascular fold exists as the plica that forms the superior ileo-cæcal fossa. The posterior vascular fold with its distinct blood vessel, exists in man as the mesentery of the appendix; while the fold in the human subject that has been termed the bloodless fold persists as the remains of the true mesentery of the cæcum and the appendix. The human appendicular mesentery is a substituted mesentery. The true serous fold of that process is represented by the non-vascular plica that runs from the surface of the ileum to the substituted mesentery of the appendix.

In the only anthropoid ape that I have had the opportunity of examining (a Silvery Gibbon), it is obvious that the condition of these folds is approaching that met with in the human subject (Fig. 15 C and D). The true appendicular mesentery is becoming less conspicuous; while the posterior vascular fold is unduly prominent, and forms, in fact, the greater part of the said mesentery. The specimen, indeed, shows the middle stage in the process of substitution—a process that is completed in the cæcum of man.

As an interesting comment upon the relations between these cæcal plicæ in man and in the lower animals, I had the good fortune to find two examples in the human subject of reversion to the lower condition. One specimen was from a female aged 70 (Fig. 17 A); the other from a male aged 64. In both, the cæcum was of simple and rudimentary outline; in both, the appendix was short and straight; and in both, its mesentery was formed entirely by what has been termed the bloodless fold—that is, the true mesentery. The substituted mesentery was represented by the slight fold *x*, which carried a branch of the ileo-colic

artery, from which the appendix was supplied. In both, there was a slight superior fossa. It will be seen that these specimens exactly reproduce the condition met with in certain of the apes. (Compare Fig. 15 B.)

When the appendicular mesentery becomes displaced to the right, by the disproportionate growth of the cæcum, and appears at last to be attached vertically to the back of the caput coli (as already described), the bloodless fold—the representative of the true mesentery—of course follows it. As the appendix mesentery is encroached upon and taken into the covering of the cæcum, so the bloodless fold acquires unusual attachments (see Figs. 16 A, B, C, and D), until, at last, it may become quite dissociated from both the appendix and its serous fold; and, in such a specimen as is shown in Fig. 16 D, it is difficult to understand, at first, that the purposeless-looking fold at the back of the cæcum is all that represents the true mesentery of the vermiform process.

21.—Other Cæcal Folds.

There are certain other folds of peritoneum in connection with the cæcum that are of inconstant character, and that may be briefly disposed of. These plicæ are, for the most part, found along the line at which the peritoneum is reflected from the back of the cæcum on to the posterior abdominal parietes. They can, therefore, only be displayed when the caput coli has been turned upwards (Fig. 17 B). They are usually placed vertically, and run from the back of the colon to the peritoneum covering the psoas or iliacus muscles. Very often they arise at the root of the appendix, or are continued down from the mesentery of that process (Fig. 17 B). In length and depth, they show the greatest variations. When two exist, they may enclose a fossa (Fig. 17 B).

These fossæ represent those termed retro-cæcal by some anatomists. They are, however, not deserving of a special name. They are rare, are most variable, and evidently more or less accidental. Some appear as mere shallow grooves, while others are large enough

to take a bantam's egg. They can hardly be demonstrated, unless the cæcum be put upon the stretch. It may be noted, however, that these retro-cæcal folds have much to do with keeping the cæcum in position. Folds are also often found at right angles to the long axis of the gut, and passing from the colon near the cæcum, transversely across the iliacus muscle. These folds are very irregular, and can often be more or less entirely obliterated by displacing the large intestine. They do not merit anatomical recognition.

22.—The Ascending and Descending Colon.

In the adult, the ascending and the descending parts of the colon are placed vertically, while the direction of the transverse colon is practically horizontal. It is not quite horizontal, because the splenic flexure is on a higher level than the hepatic flexure, as well as posterior to it. This mutual relation between the three chief parts of the large intestine is not to be observed until some little time after the commencement of extra-uterine life. If the colon of a fœtus from four to five inches in length be examined *in situ*, it will be seen that the descending segment is vertical, and that the splenic flexure is well marked, and is the highest point of the colic arch (Fig. 18 B). The ascending colon, however, is by no means vertical, and the hepatic flexure can hardly be said to exist. In fact, the bowel between the splenic flexure and the cæcum follows an oblique line from above downwards and to the right.

This line may be taken to represent the course of the cæcum as it passes from left to right in the process of development. The particular position assumed by the segment of the colon to the right of the middle line is rendered necessary by the large size of the liver, along the under surface of which the bowel runs.

This disposition of the large intestine is still marked in the fœtus at full term, and may even be noticed sometimes in young subjects up to the age of two or three years. Thus the specimen from which Fig. 18A was drawn was from the body of a female child aged two years. It is not until the liver has regained its normal proportions with reference to the other abdominal viscera that the hepatic flexure becomes well

marked, and the right segment of the colon acquires the position that is familiar in the adult.

The period at which the cæcum reaches its final resting place in the right iliac fossa is evidently liable to considerable variation. Thus, in fœtuses measuring respectively $4\frac{1}{2}$ and $5\frac{1}{2}$ inches, I have found the cæcum on a level with the lower end of the right kidney, while, in several fœtuses at full term, the caput coli has still occupied a position immediately under the liver, and there has been no large intestine in the place of the ascending colon.

25.—Non Descent of the Cæcum.

It is well known that the cæcum may remain undescended throughout the whole period of existence. I have met with two examples of this condition in the hundred bodies examined. Both subjects were males; one was 41 years of age, and the other was 74. The disposition of the cæcum was identical in the two cases. No large intestine occupied the position of the ascending colon. The cæcum was placed on the right side, immediately under the liver, and just to the right of the gall-bladder. It was quite horizontal, continued the long axis of the transverse colon, and was included between the layers of the transverse mesocolon. The appendix came off from the posterior aspect of the cæcum. It was normal, as were also its folds. Its mesentery joined the upper layer of the transverse mesocolon. From the extremity of the cæcum, a horizontal fold of peritoneum was continued to the parietes, and upon it the edge of the liver rested.

In one of these instances, the segment of colon from the tip of the cæcum to the splenic flexure measured 38 inches, and it was only to the left half of this portion that the great omentum was attached. In this instance, also, the descending colon was unduly long, measuring 15 inches. In the other example, the bowel, from the tip of the caput to the splenic flexure measured 27 inches; the great omentum commenced 5 inches from the first named point. The descending colon was of normal length. In both cases the remaining viscera were normal, and there were no evidences of intra-uterine peritonitis

In two other adult bodies, the cæcum lay in the right iliac region, but both it and the whole of the ascending colon were entirely free from any peritoneal connections with the posterior parietes. The gut, from the tip of the cæcum to the hepatic flexure, was entirely invested by peritoneum continuous with the mesentery. In fact, this part of the colon was covered in the same manner and by the same fold as the small intestine; and a condition was produced identical with that met with in many animals. The portion of large bowel thus free measured eight inches in both instances. The mesentery lacked its usual attachment to the posterior abdominal wall, and its root was represented by the interval between the duodenum and the transverse colon. The membrane had indeed no other than its original primary attachment, and the small intestine and ascending colon formed together a loop that practically represented the condition of the great primary intestinal loop.

It is evident that if a right lumbar colotomy had been attempted in any one of the four subjects last described, the large intestine would not have been found. In connection with these and like malformations of the colon, reference must be made to the very valuable monograph of Mr. Lockwood (*British Medical Journal*, vol. ii., 1882, page 574). The importance to the practical surgeon of Mr. Lockwood's work cannot be too strongly spoken of.

The average *length* in the adult of the ascending colon (as measured from the tip of the cæcum to the hepatic flexure) is eight inches, and of the descending colon (as measured from the splenic bend to the commencement of the sigmoid loop) eight inches and a half. The descending colon is the part of the large bowel that is least liable to variation. It is the only part of the gut, except the duodenum, that retains its original position as a portion of the great primary vertical loop. This segment of the intestine may sometimes be convoluted, and the longest descending colon that I have met with measured fifteen inches.

24.—The Meso-colon.

Considerable importance attaches, from a surgical point of view, to the frequency with which a meso-colon may be anticipated in connection with the vertical parts of the large intestine. With this anatomical circumstance, the operation of lumbar colotomy is very intimately concerned. The usual statement made in surgical text-books upon this subject, is to the effect that a meso-colon is more often found upon the right side of the body than upon the left; and this statement is used as one argument in support of left lumbar colotomy.

I made a careful examination of the peritoneal investments of these parts of the colon in the hundred subjects dissected, with the following result. In fifty-two bodies (that is, in about one-half), there was neither an ascending nor a descending meso-colon. In twenty-two there was a descending meso-colon, but no trace of a corresponding fold on the other side. Infourteen subjects there was a meso-colon to both the ascending and the descending segments of the bowel; while, in the remaining twelve bodies there was an ascending meso-colon, but no corresponding fold on the left side.

It follows, therefore, that in performing lumbar colotomy, a meso-colon may be expected upon the left side in 36 per cent. of all cases, and on the right side in 26 per cent.

From the standpoint of development and comparative anatomy, it would certainly be expected that a descending meso-colon would be much more frequently met with than an ascending meso-colon. In the lower animals the former membrane is always extensive and conspicuous. It is well marked in all species of monkey, and even in the anthropoid apes. It is the remains of the primary vertical fold of peritoneum, whereas the ascending meso-colon is a secondary production, a fold acquired by a certain phase in the development of the bowel.

The line of attachment of the left meso-colon is usually along the outer border of the kidney, and is vertical. The attachment, therefore has been moved some distance from the middle line, along which it would have originally extended. The line of attachment of the

ascending meso-colon is, as a rule, less vertical, and is found crossing the lower end of the kidney from right to left, and then ascending along the inner margin of the gland.

In like manner, when these folds are entirely absent, the left colon will be found to be adherent to the parietes along the outer border of the kidney, while the right will be fixed a little obliquely to the anterior surface of the lower end of the corresponding gland, and then along its inner margin. The ascending meso-colon will vary in breadth from one inch to two inches, while the fold on the left side will vary between one and three inches.

In small fœtuses, up to some five or six inches in length, the descending meso-colon will usually be found as an extensive fold. The attachment will be vertical, but nearer to the middle line than in the adult. In such subjects, indeed, it will be usually found attached along the inner border of the kidney, a position that it may sometimes be found to occupy in the adult. At this period of intra-uterine life an ascending meso-colon is very rarely to be met with, and even in the fœtus at full term it would appear that this fold of peritoneum is less frequently present than it is in the adult. In the fœtus the cæcum and commencement of the ascending colon will be found entirely invested by peritoneum, but above the parts so invested the colon will be commonly found to be adherent along an oblique line to the front and inner aspect of the kidney.

In the fœtus at full term, if the cæcum be still undescended and in contact with the liver, it is not uncommon to find the upper part of the descending colon provided with a meso-colon, while the lower part is adherent to the front of the kidney. This meso-colon in reality belongs to the transverse meso-colon, and when the intestine is fully developed there is no doubt that the portion of the descending colon so invested is drawn towards the right, and becomes a part of the transverse segment of the gut.

23.—Sustentaculum Hepatis.

There is sometimes found connected with the ascending colon a fold of peritoneum, to which I would suggest that the name of the

sustentaculum hepatis may well be applied. It is comparable with the fold from the descending colon that is known as the sustentaculum lienis. The process in question is found extending from the right side of the ascending colon to the parietes at, or a little above, the level of the highest part of the iliac crest. Its free border is concave, and looks directly forwards. Its width is about one inch and a half, and its depth (from before backwards) about two inches. It forms a shelf, upon which rests the extreme right margin of the liver. I have met with eighteen well marked examples of this fold in one hundred bodies.

It is needless to point out that the position of the liver is subject to some variation. In the fœtus, at full term, its lowest point usually reaches the crest of the ilium; and this edge may retain the same relation to the bone for several months, and even for two or three years after birth. In the adult, also, it is not very unusual to find the lowest margin of the liver extending to within a short distance of the iliac crest, and this, too, when the gland is perfectly normal in appearance. This relation is certainly more marked in women than in men, and may depend, to some extent, upon the use of stays. With three exceptions, the sustentaculum hepatis was associated with a liver that reached either the level of the iliac crest, or a point but a little way above it. It would appear as if the gland had pushed the fold of serous membrane before it, although, in each instance, the fold was a permanent one.

With regard to the exceptions, in two instances the fold came off from the upper part of the colon, and reached the parietes at the level of the tip of the eleventh rib. In the remaining case it came off from the hepatic flexure, and supported a liver that occupied a quite normal position. Of the eighteen individuals, eleven were females and seven males; twelve were under the age of three years, and the remainder were adults. In two instances the fold formed, with another transverse fold that came off lower down from the upper part of the cæcum, a deep fossa, the mouth of which looked directly forwards.

26.—The Transverse Colon.

This segment of the large intestine is liable to considerable variation in length, position, and arrangement. Its average length is 20 inches in the adult. The shortest measurements noted in this part in adults were respectively 12 and 13 inches, and the longest respectively 29, 30, and 33 inches.

It is obvious that the transverse portion of the intestine, when presenting the dimensions last named, cannot follow a straight, or evenly curved line from the hepatic to the splenic flexure. In every adult body examined, I placed a thread transversely across the abdomen (after that cavity had been opened) at the level of the highest point on the iliac crest, and noted the relation that the transverse colon bore to it. In the majority of cases, the superficial part of the colic arch (that part that was exposed when the viscera were viewed *in situ*, before being disturbed) was either in whole, or in greater part, above this line. In the remaining instances it was in whole, or in greater part, below it. The proportion of the two sets of cases to one another was as four to one.

The point of greatest anatomical interest in connection with the transverse colon has reference to certain remarkable bends that are sometimes formed by this part of the bowel. The bending is always in the same direction—namely, downwards—and is usually abrupt and angular. The deviations in outline produced can be conceived by imagining some part of the colic arch abruptly displaced downwards towards the pelvis, so that V- or U-shaped bends are produced. The apex of the V or the bend of the U may reach the pubes, and may even become adherent, when peritonitis has existed, to the pelvic parietes, or to some of the pelvic viscera; or one limb of the V may become adherent to the whole length of the ascending colon, and so produce what may appear at first sight to be a double ascending colon; or the other limb may attach itself in a like fashion to the descending part of the gut, and produce a similar appearance on the left side. These deviations have from time to time attracted the attention of pathologists, and I have entered somewhat fully into the literature of

the subject in my Jacksonian Prize Essay. The first notice that I can find of these deviations is by Dr. Bright, in his monograph on *Abdominal Tumours.* In that work, he gives both a description and a drawing of the condition, or of at least one phase of it.

From a systematic examination of the intestine in the hundred bodies, I am disposed to think that these deviations in the colic arch may be due to two distinct causes: to the effects of distension on the one hand, and to a congenital malformation on the other. With regard to the first-named cause, it is to be noted that the longest and most irregular transverse colons are met with in subjects in whom the large bowel is distended and occupied by much fæcal matter. Such individuals have probably been the subjects of chronic constipation, and have, more or less constantly, presented a distended state of the colon.

Now, if one of these long, loose, transverse colons be artificially distended with water, it will be observed that, when the distension has reached a certain degree, the centre of the colic arch begins to descend in the median line, so that a symmetrical V- or U-shaped bend is produced. In many bodies, especially in those where the bowel is loaded, slight degrees of this bending may be noticed, whereby the centre of the colic arch is brought below the umbilicus. Such a curve may probably be produced simply by the weight of the contained fæcal matter. In marked instances, the apex of the bend may reach the pubes (Fig. 19 C), and of this condition I have met with four examples. If, when such an extreme bend exists, peritonitis be present, it is easy to understand that one limb of the bent arch may become adherent to the ascending or descending colon, and so produce the appearance of a double intestine.

The bends, on the other hand, that I have ventured to think may be congenital, are of a somewhat different character, and possibly represent a return to a distortion of the colon that is constant and pronounced in many animals.

If the colon of a fœtus, of about five inches in length, be examined *in situ*, a sharp but slight bend will often be noticed in the transverse section just to the left of the middle line (Fig. 18 B). In the large bowel of a fœtus at full term, or even of a child of one or two years of

age, a similar, but more pronounced, bend will be not unfrequently observed in the same portion of the gut (Fig. 18 A). In both these figures, the part of the bowel from which the great omentum arises is indicated by shading.

In five instances, in adult bodies, I have found a bend in the right side of the colon of like description to that just named (Fig. 19 A); and, in one of the examples, the distortion was of such a degree that the apex of the bend reached the pubes (Fig. 19 B). In two of the cases, the malformation was rendered permanent by adhesions that were apparently non-pathological.

In four adult bodies, moreover, I have met with a like bending in the left angle of the colon, the great omentum being attached to all the distorted part (Fig. 19 D); and here also, in two examples, the bend was secured by adhesions that did not appear to be normal. Although it may be expected that the effects of distension would tend to show themselves at the colic flexures, yet, in these nine examples, gross evidences of distension were lacking, and the bowel was not of undue length. In no instance was any other abnormality detected in the nine subjects. These distortions of the colon will be seen to bear some resemblance to those that are constant in many animals, of which examples are afforded by the large intestine of the Spider Monkey (Fig. 18 C), and of a Lemur (Fig. 18 D).

27.—The Sigmoid Flexure and Rectum.

The accepted account of this part of the bowel that is given in anatomical text-books is as follows. The sigmoid flexure is said to be situated in the left iliac fossa, and to consist of a double bending of the bowel in the form of the letter S. It joins with the rectum at the pelvic brim, opposite the sacro-iliac synchondrosis; it is attached, by a distinct meso-colon, to the iliac fossa, is very movable, and falls into the pelvis when the bladder is empty. The rectum is divided into three parts; the first part commences at the sacro-iliac synchondrosis, and passes obliquely down from left to right, forming a gentle curve to the right, and ultimately gaining the middle line opposite the third piece of the

sacrum; it is entirely invested by a fold of peritoneum called the meso-rectum. The second part extends along the concavity of the sacrum as far as the coccyx, at which point the third part begins, and inclines at once backwards to terminate at the anus.

This account is very ancient, and has been handed down from book to book through many generations.

The descriptions given of the second and third parts of the rectum (the portions beyond the point of ending of the meso-rectum), I would fully endorse, both as regards the direction and position of the gut, and its relations to the serous membrane.

But although I began to investigate these parts with a full belief in the ancient account, I must confess that, in the hundred bodies, I have never seen such a sigmoid flexure, nor such a rectum. I would go so far as to state that the flexure does not occupy the iliac fossa, that its meso-colon does not arise wholly from that fossa, that its course is not that of either the letter S or the letter Σ, and that the first part of the rectum is not disposed in the manner familiarly described.

The segments of gut termed the sigmoid flexure and the first part of the rectum form together a single simple loop that cannot be divided into parts. This loop begins where the descending colon ends, and ends at the commencement of the so-called second piece of the rectum; at the spot, in fact, where the meso-rectum ceases, opposite about the third piece of the sacrum. This loop, when unfolded, describes a figure that, if it must be compared to a letter, may well be compared to the capital Omega. If at any time new terms should be introduced, it might be well to call all that segment of the bowel between the ending of the descending colon and the ending of the meso-rectum the omega loop, and to limit the term "rectum" to the short piece of practically straight gut that is now described as the second and third part of the rectum.

The *length* of this sigmoid or omega loop in the fœtus has been already mentioned. Its average length in the adult is 17½ inches. The longest loop met with (in a male aged 28) measured 27 inches, and the shortest (in a female aged 70) measured 6 inches only. This latter specimen was of a very exceptional character.

In a small fœtus, about five inches in length, the coil forms a simple loop in the abdomen that is directed upwards and to the right, and that crosses the middle line (Fig. 18 B). In the fœtus at full term the coil may have practically the same outline and position, its apex reaching to the transverse part of the duodenum (Fig. 20 A), or it may have already begun to bend down towards the pelvis (Fig. 20 B). In the adult, the most usual shape of the unfolded loop is shown in Fig. 20 C, where it will be seen to describe a fairly regular curve. In this figure, M is at the termination of the descending colon, N at the point of ending of the meso-rectum. The normal position of this loop is not in the left iliac fossa, but wholly in the pelvis. By the age of four weeks I have found the whole of the sigmoid flexure within that cavity.

The circumstances under which the flexure is found without the pelvis are the following: when the bladder or uterus is distended, when a large cæcum occupies the pelvis, when the loop itself is greatly distended. With regard to the latter point, it may be noted that, as distension increases in the omega flexure, the loop at first rises out of the pelvis, and occupies by its apex the right iliac region; it next mounts up to the region about the umbilicus, and, in extreme distension, may reach the under surface of the right lobe of the liver. It assumes, indeed, at last, the outline and position of the fœtal sigmoid flexure. I have more than once, in the adult, found the apex of a distended sigmoid or omega loop lying in contact with the transverse colon, or on a level with a transverse part of the duodenum. In one instance, the summit of the loop was fixed by morbid adhesions to the transverse duodenum.

Taking the average in all the specimens examined, the most usual arrangement of the omega loop, when *in situ*, is the following. The descending colon ends just at the outer border of the psoas. The gut here suddenly changes its direction. It crosses the muscle at right angles, and about midway between the lumbo-sacral eminence and Poupart's ligament. It now descends vertically along the left pelvic wall, and may at once reach the pelvic floor. It then passes more or less horizontally and transversely across the pelvis from left to right, and commonly comes into contact with the right pelvic wall. At this point it is bent upon itself, and, passing once more towards the left,

reaches the middle line and descends to the anus (Fig. 21 A). It will lie, therefore, in more or less direct contact with the bladder and uterus, and may possibly touch the cæcum. It is in very close relation with the coils of small gut that occupy the pelvis, and by these coils the loop is usually hidden. Other, but much rarer, arrangements of the loop are shown in Figs. 21 B and 22; the diagram, in each case, having been made from a fresh specimen while the parts were *in situ*, and before the sigmoid loop had been in any way disturbed.

28.—The Sigmoid Meso-colon.

The line of attachment or ground-plan of the meso-colon that attaches the omega loop is as follows (Fig. 20 c). It crosses the psoas at a right angle, and then takes a slight curve upwards, so as to pass over the iliac vessels at or about their bifurcation. The curve ends at the point *x*. This point is either situated just to the inner side of the psoas muscle, or between the psoas and the middle line, or, as is most frequently the case, just over the bifurcation of the vessels. From this point, the line of attachment proceeds vertically down, taking, at first, a slight curve to the right, to terminate at *n*. Its course is to the left of the middle line, while its ending will be upon that line.

It will be seen that, at the point *x*, the meso-colon is folded a little upon itself. From this point, also, arises that part of the membrane that goes to the summit of the loop (*y*). It is here, moreover, that the meso-colon attains its greatest length, and it is, lastly, at this spot that the sigmoid artery enters.

The average length of the meso-colon of the omega loop is as follows: over the psoas, 1½ inches; at the point *x*, 3½ inches; on the sacrum, 1¼ inches.

There is often no meso-colon over the psoas, the gut being adherent to that muscle. When a descending meso-colon exists, it joins that of the loop; and the line of attachment is then, as a rule, directed obliquely across the psoas and the lower end of the kidney, while beyond the pelvic brim the attachment is as above described.

The distance between the points M and N —the extremities of the loop—is represented by the distance between the outer edge of the psoas and the third piece of the sacrum. The ends of the loop, however, just beyond their respective terminations, are usually brought nearer together by a slight contraction of the meso-colon, the distance between the parts being then, on an average, three inches. A line drawn transversely across the meso-colon, at its widest part, usually measures four inches.

Morbid contractions and adhesions are singularly common in this meso-colon, especially in old subjects, and particularly it would appear in those liable to constipation. These contractions are most common over the psoas, and many bands are often seen passing from the left layer of the meso-colon to the peritoneum over the muscle. By such contraction, a loop of the shape figured in Fig. 20 D may be produced. By somewhat similar, and not necessarily morbid, contractions loops of the shapes shown in Fig. 20 E, F, and H, may be brought about. In the species of loop shown in Fig. 20 G, the two ends of the bowel are brought close together, so close as to be sometimes in contact. In such instances, the greatest length of the meso-colon may reach six, eight, or even nine inches.

This is the condition that especially favours volvulus of the sigmoid loop. I have met with six instances of this form, all the subjects being adults past middle life. In one remarkable specimen, the gut from the end of the descending colon to the third piece of the sacrum measured only six inches. It formed a perfectly simple bend over the psoas, and had no meso-colon of any kind. It was met with in the body of a male aged 70.

From the left side of the meso-colon, folds of peritoneum are often found passing down to the brim of the pelvis, to the broad ligament, to the psoas muscle, and to the iliac fossa. They tend greatly to keep the flexure in position, but are not sufficiently constant to be classified. Large fossæ or depressions may be formed between these folds when more than one exists.

29.—The Intersigmoid Fossa.

The opening of this fossa is seen on the left wall of the meso-colon, when the loop is drawn forwards and upwards. The pouch is formed between the layers of the meso-colon, and is due to a turning in of a funnel-shaped process of the peritoneum. The opening is usually found in the meso-colon at the point *x* (Fig. 20 c), but more especially when this point lies over the bifurcation of the iliac vessels. The floor of the pouch is adherent to these vessels, and through the transparent floor the ureter can usually be seen crossing the artery.

In other and less common instances, the fossa is removed from the root of the meso-colon, and is found some way up upon that membrane, it may be midway between the parietes and the gut, or found even nearer to the bowel than to the attachment of the serous fold.

The long axis of the pouch is directed downwards and to the left. The orifice is round or oval, with a thin distinct sharp edge that shows an absence of blood vessels. The sigmoid artery lies above it, and to the right. It is by the last-named vessel that the fossa is produced. This trunk is usually shorter than the meso-colon in which it runs; that membrane is therefore drawn upon, so as to present a funnel-like depression where the artery reaches it. A deepening of this depression constitutes the fossa.

The fossa varies in depth from 1 to 1½ inches. It will usually lodge the forefinger up to the first joint. In one case it accommodated the entire thumb, and in a solitary instance (in a female aged 17) it was so large as to lodge conveniently three fingers up to the joints between the first and second phalanges.

When the fossa is in its usual place, at the brim of the pelvis, its direction corresponds to that of the sigmoid artery; when it is removed from the brim, it may take very varied directions. In a few specimens, the orifice of the fossa would only accommodate a No. 7, No. 10, or No. 12 catheter, although the depth of the pouch varied in these cases from an inch to half an inch. In three specimens the orifice was valvular.

The true fossa is not met with in small fœtuses. It is quite rare in the fœtus at full term, although at that period it is very often represented by a funnel-shaped depression. In older subjects, it is frequently quite obliterated by the adhesions alluded to. The perfect fossa was met with in 52 per cent. of all the subjects. But if distinct funnel-shaped depressions be added to the examples of the true fossa, then the percentage reaches 65 per cent.

The sigmoid artery, as it descends to the meso-colon, forms a very distinct fold in the upper layer of that membrane, that is placed at right angles to the long axis of the bowel. It would appear that it is usually about this fold—as about an axis—that volvulus takes place. From a point on the left layer of the meso-colon corresponding to the plica, another fold may arise and pass down to the pelvic brim or the broad ligament. In such a case, there will be no true sigmoid fossa.

Two cases of strangulated hernia in the intersigmoid fossa have been recorded—one by Lawrence, and one by Mr. Eve, in the Erasmus Wilson lectures, delivered at the Royal College of Surgeons in 1884.

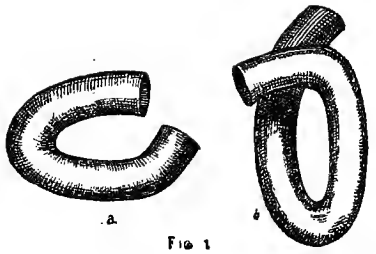


Fig. 1

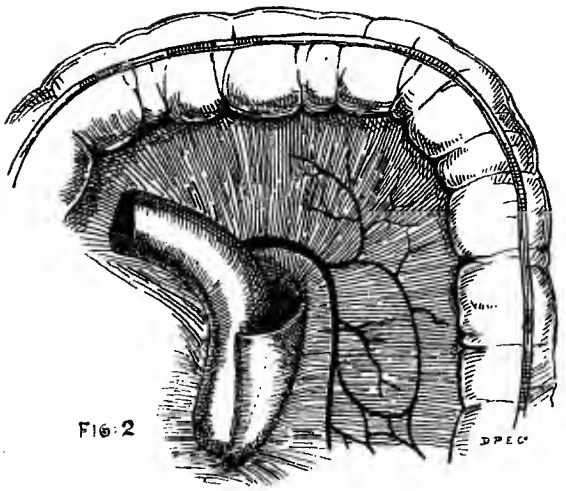
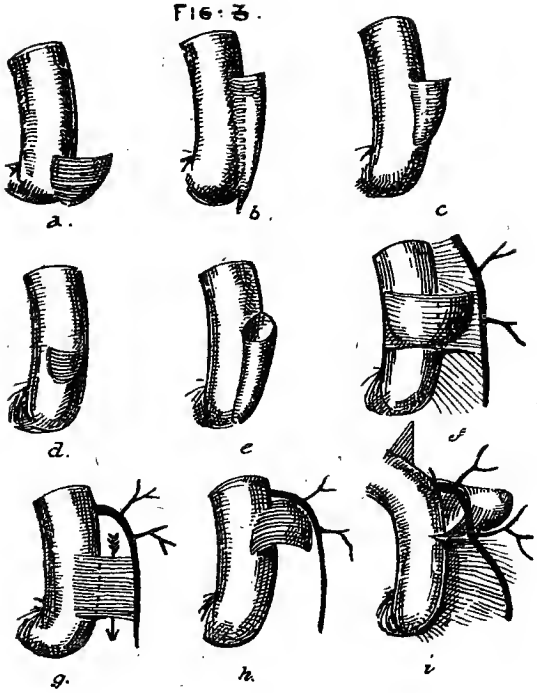


Fig: 2

Fig: 3.



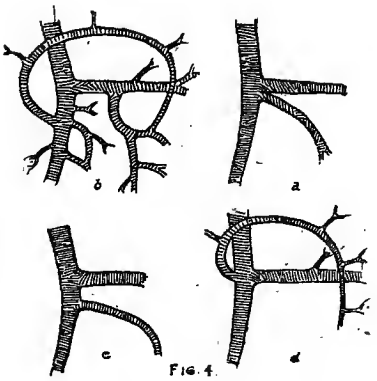


Fig. 4.

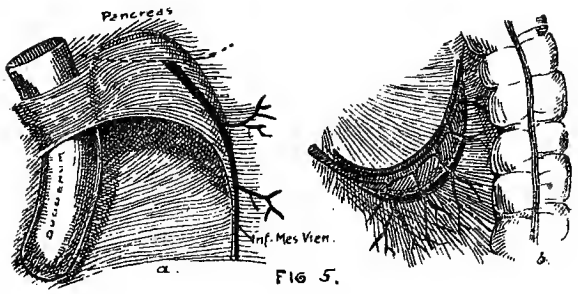
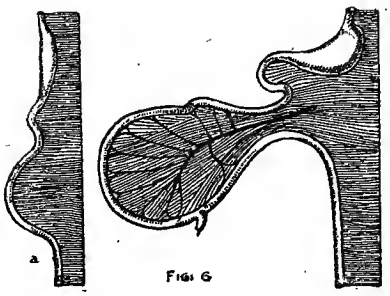


Fig 5.



Figs 6

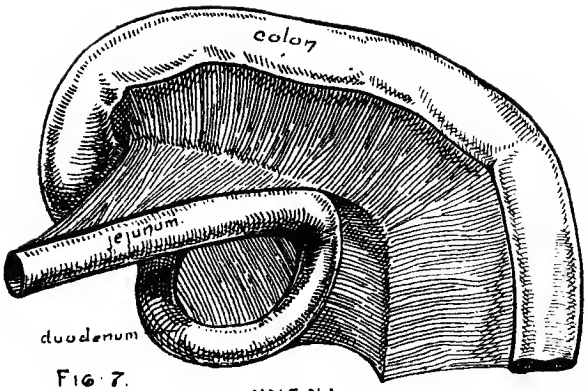


FIG. 7.

HYÆNA.

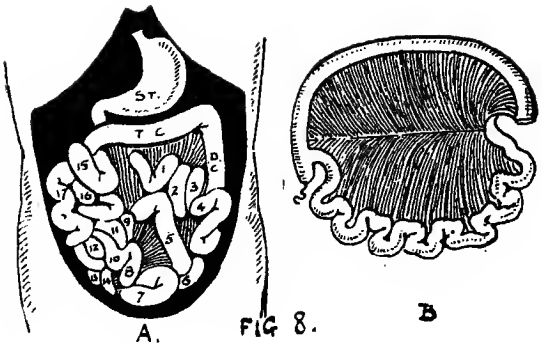


FIG 8.

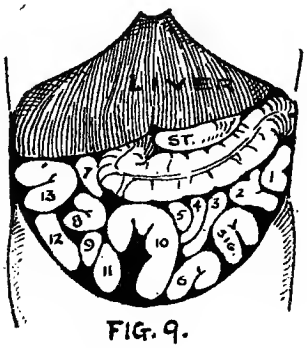


FIG. 9.

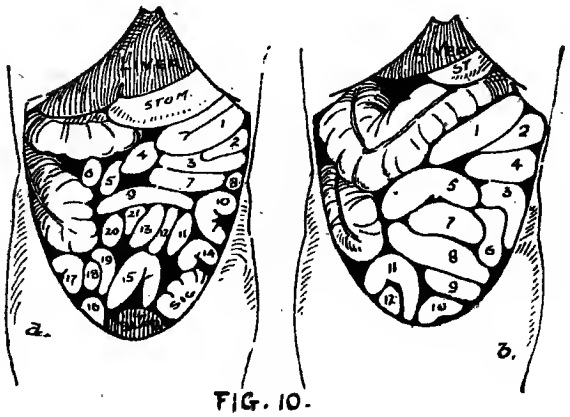


FIG. 10.

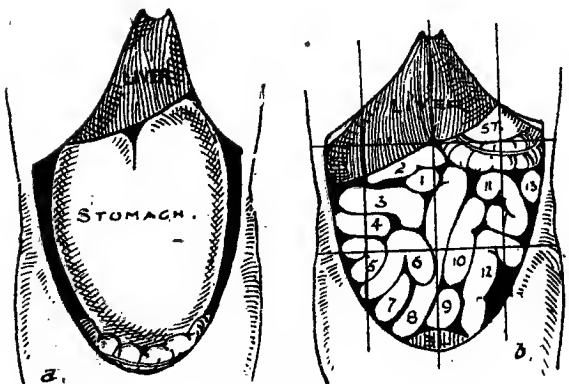


FIG. 11.

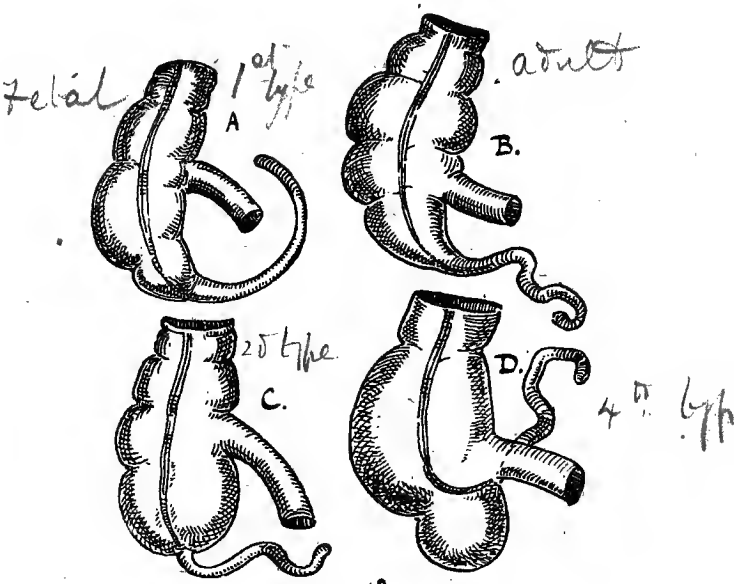


FIG. 12

Human; 4 types

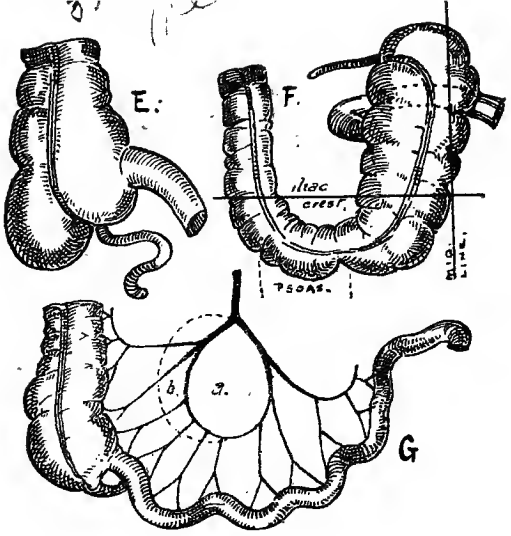


FIG. 13.

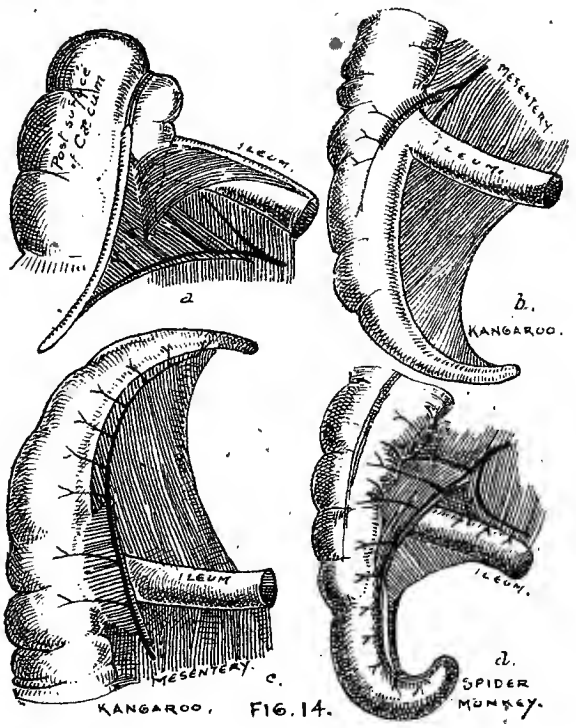


FIG. 14.

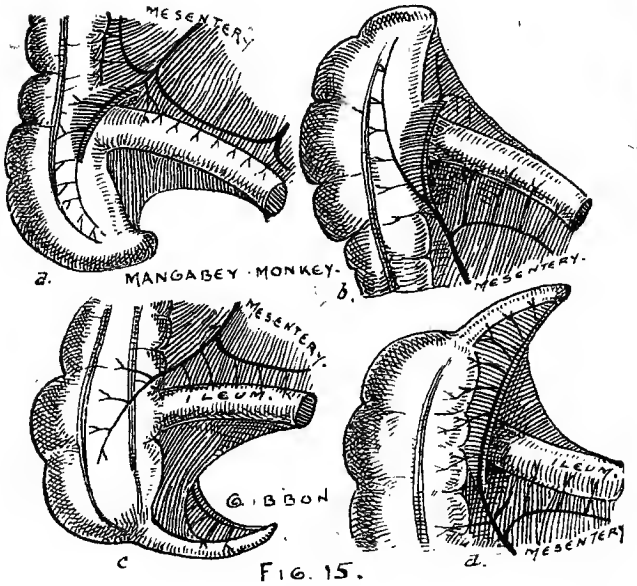


FIG. 15.

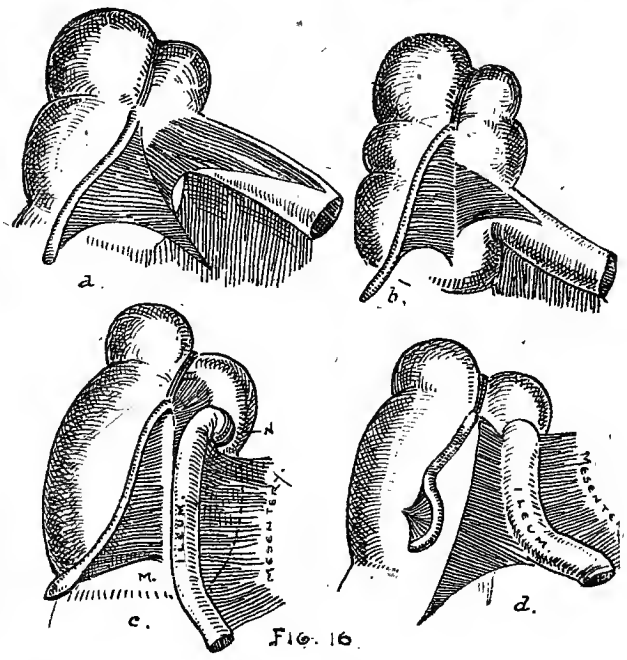


FIG. 16.

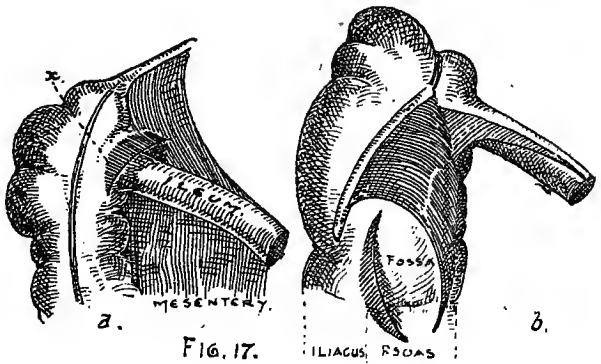


FIG. 17.

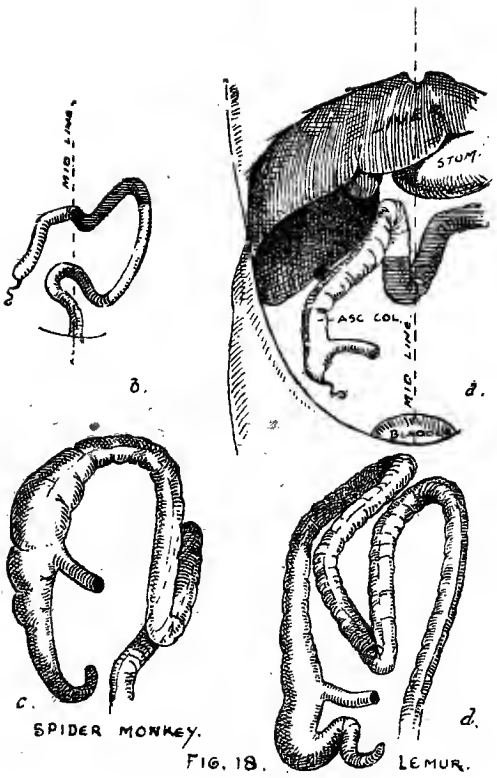


FIG. 18.

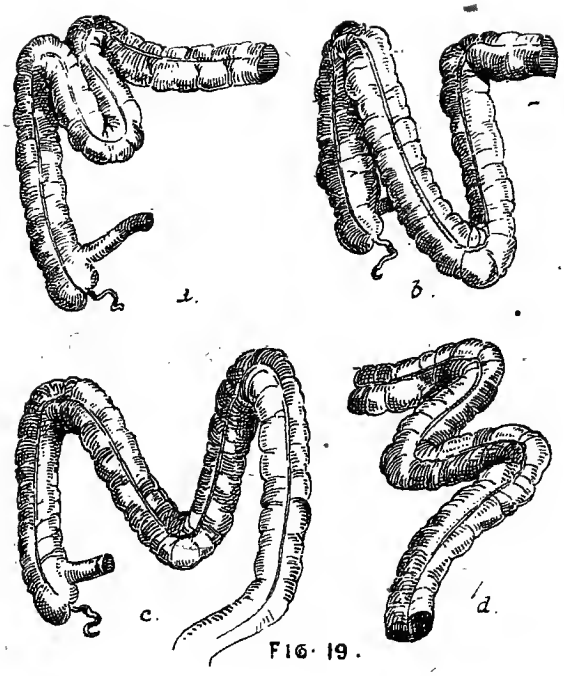


FIG. 19.

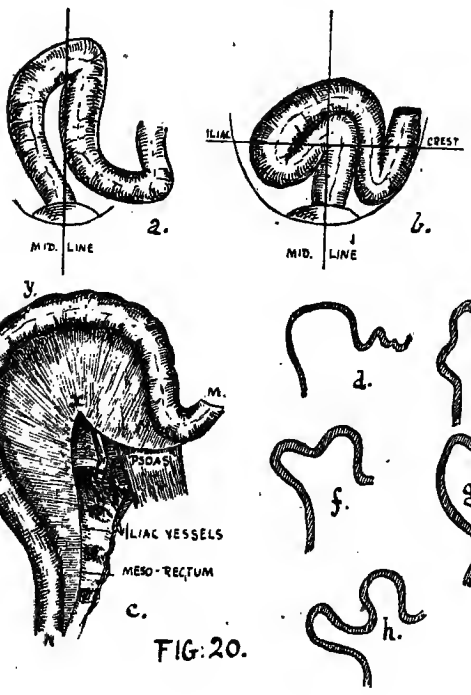


FIG. 20.

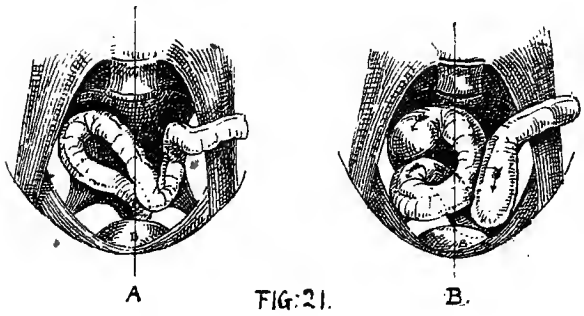


FIG. 21.

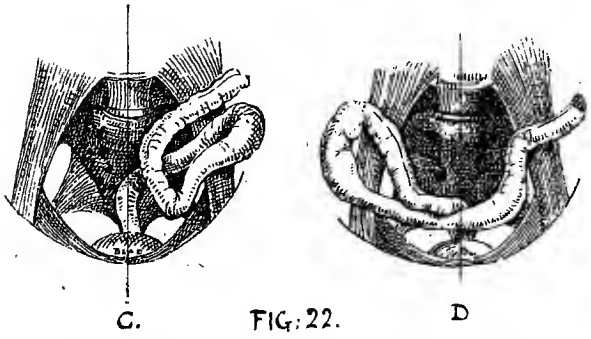


FIG. 22.